



SBIR

**Small Business
Innovation
Research
Program**

**ABSTRACTS OF
AWARDS FOR
FISCAL YEAR 1998**

U.S. Department of Commerce

INTRODUCTION

In July 1998, the Department of Commerce (DOC), through the Small Business Innovation Research (SBIR) program, awarded 45 Phase 1 contracts. These awards of up to \$75,000 each, and totaling approximately \$3.1 million are for a 6-month effort to demonstrate the feasibility of innovative approaches to the research topics identified in the DOC SBIR Program Solicitation for FY 98 (DOC 98-1). Abstracts of the successful proposals submitted under this solicitation, and brief comments on their potential commercial applications, are provided in this publication.

In Phase 2, funding is provided for projects that appear most promising after Phase 1 is completed. These awards can be for up to \$200,000 each and for 2 years. Phase 3 is the commercialization phase which uses non-SBIR funding to pursue potential commercial applications of the project. The DOC awarded a total of 19 Phase 2 contracts in FY 98 for a total of approximately \$3.7 million. Abstracts of successful Phase 2 proposals and comments on their commercial applications are also provided in this publication.

The SBIR program is highly competitive. A total of about 350 proposals were received by DOC in response to its FY 98 solicitation. The proposals were independently reviewed by DOC scientists and/or engineers. With the funds available, only 45 could be selected. Final selection was based upon the results of the reviews, relative importance to DOC needs, relationship to on-going research, and potential for commercialization.

FY 98 Phase 1 Award Winner

TOPIC: 8.1 Atmospheric and Hydrological Sciences

SUBTOPIC: 8.1.2A Site Specific Analysis and Display of Tornado Hazard Potential

TITLE: Site-Specific Tornado Hazard Analysis and Display System

FIRM: Computational Geosciences, Inc.
330 West Gray, Suite 500
Norman, OK 73069

PRINCIPAL INVESTIGATOR: Carl H. Levison
405-360-0472

AWARD AMOUNT: \$50,000

ABSTRACT:

Computational Geosciences will perform the research and system analysis and design for a PC-based Site-Specific Tornado Hazard Analysis and Display System (SSTHADS). This system will significantly enhance the capability to assess the potential hazard of tornadoes for specific geographic areas and make the NWS' Tornado Database widely available. In addition, it will enable an end user to make effective use of the database without having detailed knowledge of the data or its format.

We will evaluate appropriate statistical methods that preserve the integrity and validity of all inferences made on the data, develop a "tornado hazard model," address the observational biases in the data, provide a tornado climatology for the U.S., and allow end users to perform an advanced statistical analysis. In addition, we will explore incorporating features in the design such as 1) Internet access, 2) Java-based application design, 3) an interactive interface that allows the user to select the geographic areas of interest and statistical analysis to be performed, 4) an interface to a Geographical Information System (i.e., ARC/INFO) that enables extended analysis of the site-specific tornado hazards data with the user's other spatial data.

Computational Geosciences will use a rapid prototyping approach in designing the system.

COMMERCIAL APPLICATIONS:

SSTHADS has commercial application in a PC software package or services offering to organizations that have responsibility (or vested interest) in mitigating costs of tornado related disasters. This includes organizations such as insurance companies, government agencies at all levels (e.g., office of emergency preparedness), engineers, and homebuilders associations. These end user or buyers represent a significant market for the Site-Specific Tornado Hazard Analysis and Display System.

FY 98 Phase 1 Award Winner

TOPIC: 8.1 Atmospheric and Hydrological Sciences

SUBTOPIC: 8.1.4A Automated Airborne Measurement of Atmospheric Chemical Species

TITLE: Automated Airborne Measurement of Ozone

FIRM: ADA Technologies, Inc.
304 Inverness Way, Suite 265
Englewood, CO 80112

PRINCIPAL INVESTIGATOR: Patrick D. French
303-792-5615

AWARD AMOUNT: \$74,992

ABSTRACT:

This Phase 1 SBIR proposal addresses the need for a compact, inexpensive, automated instrument capable of making frequent, highly accurate ozone measurements from onboard commercial aircraft. NOAA currently plans to permanently mount ozone instruments on a fleet of commercial aircraft to make measurement of ozone in the troposphere world-wide. The cost of carrying large commercially available ozone instruments on commercial aircraft would be quite significant, therefore it is imperative to design and build a new light weight, compact, inexpensive, highly automated ozone instrument. The ozone instrument proposed will be small, and allow easy mounting on commercial aircraft, with minimum impact on the normal operations of the aircraft.

The proposed ozone instrument is based on existing designs from the University of Colorado's Cooperative Institute for Research in Environmental Sciences. This instrument has made ozone measurements from flight platforms including small aircraft, kites, and balloons. In Phase 1, this UV absorption ozone instrument will be refined and integrated with a patented datalogger, previously developed by ADA Technologies to create a low cost, small, rugged and totally automated instrument. The Phase 2 instrument will interface to the standard ARINC 429 data bus to receive aircraft position, altitude, and time, which will be logged with corresponding ozone values.

COMMERCIAL APPLICATIONS:

The initial application for this instrument would be in the NOAA program for measuring atmospheric ozone. A potentially much larger market would be in the expendable sonde market. Hundreds of balloon-borne ozonesondes are launched every year, and this instrument should have a cost comparable to that of the electrochemical sondes presently employed, while offering improved accuracy and ease of use. A second area of interest would be in photocopy centers where photocopiers can produce significant amounts of ozone. This instrument could be used to monitor these ozone levels and provide warnings if unsafe levels exist.

FY 98 Phase 1 Award Winner

TOPIC: 8.1 Atmospheric and Hydrological Sciences

SUBTOPIC: 8.1.9A Satellite Communications for Global Drifting Buoy Arrays

TITLE: Data Relay System for Drifting Buoys Utilizing Low-Earth Orbit Satellites

FIRM: NAL Research Corporation
14318 Montverd Court
Centerville, VA 20121

PRINCIPAL INVESTIGATOR Ngoc T. Hoang
703-803-1418

AWARD AMOUNT: \$74,924

ABSTRACT:

NAL Research Corporation proposes to develop a data relay system, which collects environmental data from drifting buoys and delivers them to users worldwide, utilizing low-earth orbit (LEO) satellites and the global positioning system for accurate location determination. Under the Phase 1 research effort, a comprehensive set of top-level requirements will be established and will be used to identify the most applicable LEO system for drifting buoys. The proposed system will offer truly global coverage. When data are sent from a drifting buoy, the signals are received immediately by one of the LEO satellites and relayed in real-time to the Global Telecommunications System and/or directly to the scientists through commercially available e-mail. The entire process can take less than a few seconds. This will provide electronic global access to drifting buoys from any place that has a phone line, access to the Internet and a computer or a hand-held satellite receiver and a computer. Since the proposed system is capable of two-way communications, drifting buoys can be monitored, adjusted and re-calibrated by scientists at their home laboratories or institutions. Initial instrument setup parameters can be changed in response to changing conditions and can be re-directed to examine targets of opportunity.

COMMERCIAL APPLICATIONS:

Preliminary customers will be NOAA's Atmospheric and Hydrological Sciences Program for relay of drifting buoy arrays data, NASA's Search and Rescue Office, NASA's Mission to Planet Earth for relay of science data, NASA's Environmental Research Aircraft and Sensor Technology for telecommand and control of unmanned aerial vehicles, NASA General Aviation Revitalization Program, NSF's Polar Research Program. Other potential applications include the simplification of communications for business professionals, reporters for television networks, construction engineers, geologists, people who live in thinly-populated areas.

FY 98 Phase 1 Award Winner

TOPIC: 8.2 Ocean Observations Systems

SUBTOPIC: 8.2.1A Operational Ocean Instrumentation, Measurement and Data Assimilation Systems

TITLE: Horizontal ADCP for Remote Mapping of Currents

FIRM: RD Instruments
9855 Businesspark Avenue
San Diego, CA 92131-1113

PRINCIPAL INVESTIGATOR: R. Lee Gordon
619-693-1178

AWARD AMOUNT: \$75,000

ABSTRACT:

The objective of this research is to develop a horizontal ADCP for mapping horizontal flow structure in channels, harbors and ports. The Challenge of such a system is to measure flow even through the motionless bottom could contaminate the acoustic returns. The key innovation of Phase 1 is to develop algorithms that enable routine, automatic advantage of the facts that the bottom is fixed while the water moves, and that the bottom is below the water, i.e. oriented in a different direction. Both of these characteristics produce echo signatures that can be extracted statistically from the echoes. Phase 2 will use these algorithms in the process of developing a system that can measure flow patterns in 400 m x 15 m stratified channels.

COMMERCIAL APPLICATIONS:

The first market for such a system is flow monitoring in rivers. Ports and harbors represent a slower-to-develop market, but one which should be at least as large in the long term. There is already a sizable market for crossed-path travel-time acoustic systems in rivers. A horizontal ADCP has the potential to improve river flow monitoring, to make it less expensive and to open new sites to measurement. If Horizontal ADCPs are successful in rivers, the same hardware could be used in the more difficult stratified channels. Hence, development of the river market will facilitate development of the port and harbor market.

FY 98 Phase 1 Award Winner

TOPIC: 8.2 Ocean Observation Systems

SUBTOPIC: 8.2.4A Improved Airborne Microwave Remote Sensing of Sea Surface Salinity

TITLE: Improved Airborne Microwave Remote Sensing of Sea Surface Salinity

FIRM: Quadrant Engineering Inc.
107 Sunderland Road
Amherst, MA 01002

PRINCIPAL INVESTIGATOR: Mark Goodberlet
413-549-4402

AWARD AMOUNT: \$75,000

ABSTRACT:

Research is proposed to design an improved airborne remote sensing system for measuring sea surface salinity (SSS). The system will consist of at least one low frequency (approximately 1.4 Ghz) microwave radiometer, a global positioning system (GPS) receiver and an aircraft quality pitch and roll angle sensor. Parameters other than SSS that significantly affect the over-ocean measurement made by the low frequency microwave radiometer will be identified. Methods to insure that SSS retrieval accuracy is not significantly degraded by unaccounted-for changes in these or other significant parameters will be specified. These methods are likely to include the addition of other sensors (e.g., infrared and microwave) into the new system's design. Considerable effort will be spent on antenna design and system packaging, so that operation is possible from a wide variety of aircraft. System control software, data acquisition software, and SSS retrieval algorithms that utilize user-friendly graphical user interface (GUI) techniques will be specified. Engineering drawings, parts lists and a cost budget will be provided. Alternative capabilities of the system (such as measuring soil moisture) will be discussed.

COMMERCIAL APPLICATIONS:

- 1) Water quality monitoring programs for coastal regions
- 2) Study of oceanographic processes in coastal waters
- 3) Monitoring of soil moisture as part of agricultural crop planning and crop health.

FY 98 Phase 1 Award Winner

TOPIC: 8.3 Living Marine Resources

SUBTOPIC: 8.3.1A Rapid, Sensitive, Non-Lethal Method for the Identification of Bacterial Pathogens of Salmonids

TITLE: Double Capture Amplification System for Bacterial Pathogen Detection in Fish

FIRM: ProED, Inc.
9290 Gaither Rd.
Gaithersburg, MD 20877

PRINCIPAL INVESTIGATOR: Shang Ding Shang, M.D.
301-527-1558

AWARD AMOUNT: \$75,000

ABSTRACT:

Bacterial pathogens in salmonids, such as *Renibacterium salmoninarum* and *Aeromonas salmonicida*, are difficult to identify by conventional diagnosis due to their extremely slow growth and the absence of an efficient selective medium. Diseases caused by these pathogens represent a serious problem and cause extensive economic losses. While several PCR-based assays for bacterial pathogens appear to be useful, they are generally complex laboratory procedures. Here we propose a novel method for the rapid identification of bacteria in various fish tissues. The procedure uses a tube-bound DNA oligonucleotide to capture bacterial 16S RNA from cell lysates. In the same tube, the captured ribosomal RNA is amplified by RT-PCR with Dig-dNTPs. This is immobilized upon a microtiter plate. The hybridized cDNA is then detected with an anti-Dig-alkaline phosphatase conjugated antibody. By targeting to high copy 16S rRNA molecule and coupling with double capture amplification, this method will be very sensitive and specific. It can be readily automated if a colorimetric detection system is combined. In addition this method requires very small amounts of tissue, such as a needle biopsy sample, therefore, it is also non-lethal.

COMMERCIAL APPLICATIONS:

The goal of this research is to develop a series of non-lethal assays to rapidly detect bacterial pathogens in salmonids and other fish. The major markets would include freshwater hatcheries and sea farms, conservationists, and wildlife management groups. This assay would be extremely useful both for normal health monitoring of fish populations and for the identification of pathogenic agents in fish suspected of being infected.

FY 98 Phase 1 Award Winner

TOPIC: 8.4 Ocean Science

SUBTOPIC: 8.4.2SG Aquaculture: Developing and Improving Marine Species Culture

TITLE: Continuous Culture Zooplankton System for Marine Aquaculture Feed Production

FIRM: Aquaculture Systems Technologies, LLC
P.O. Box 15827
New Orleans, LA 70175

PRINCIPAL INVESTIGATOR: Douglas Drennan
504-837-5575

AWARD AMOUNT: \$48,937.32

ABSTRACT:

Declining natural harvests are driving the development of the marine aquaculture industry. Growth of this industry will come through vertical integration of facilities. At the bottom of the pyramid is live feed production. Enhanced production of zooplankton is critical to reducing feed costs for the marine aquaculture industry. The current bottleneck for many marine finfish culture facilities is providing live feed to larval stages. Lack of large-scale, advanced technologies forces most facilities to place larvae in outdoor ponds containing natural zooplankton populations, usually resulting in tremendous mortality rates. Computerized, integrated algal/zooplankton culture systems, which improve culture stability and reliability and reduce labor costs, are needed to fully control the "base of the food chain". The overall goal of this research will be to investigate and refine an automated, integrated algal/zooplankton system. The Phase 1 objectives will be to develop design and operational protocols for the zooplankton component of the integrated system. Preliminary production capacities will be examined and an initial economic analysis will be performed to examine full-scale economic feasibility.

COMMERCIAL APPLICATIONS:

This project proposes to stabilize the "base of the food chain" production by developing an integrated algal/zooplankton culture system. Successful completion of this project will result in a marketable technology capable of reducing live feed production costs to support marine finfish and crustacean operations. Future markets would be anticipated to support the ornamental/tropical fish industries and to produce zooplanktonic species for toxicity and bioassay tests.

FY 98 Phase 1 Award Winner

TOPIC: 8.4 Ocean Science

SUBTOPIC: 8.4.2SG Aquaculture: Developing and Improving Marine Species Culture

TITLE: Hybridization of Marine Shrimp for Superior Commercial Performance

FIRM: High Health Aquaculture, Inc.
P.O. Box 1095
Kurtistown, HI 96760

PRINCIPAL INVESTIGATOR: James Wyban
808-982-9163

AWARD AMOUNT: \$50,000

ABSTRACT:

This Small Business Innovative Research Phase 1 project will determine the feasibility of producing interspecific hybrids between *Penaeus vannamei* and *P. stylirostris* – the two most important farmed shrimp species in the Americas. Each species has certain natural characteristics suited to commercial aquaculture, but each also has negative characteristics. The commercial intent of this project is to produce a superior-quality hybrid with preferred production characteristics.

This project will be a collaboration between High Health Aquaculture (HHA, a commercial company, and the shrimp pathology group at the University of Arizona (UAZ). Interspecific hybrid groups and intraspecific control groups will be produced by HHA by artificial insemination. HHA will measure comparative growth performance for the hybrid and control groups under simulated commercial conditions. Relative resistance of the reciprocal hybrids and their parent species to the viruses TSV and WSSV will be determined by virus challenge tests at UAZ. Thus, the relative production value of the species hybrids will be compared to their parent species. UAZ will use DNA technology (RAPD) to verify that true genetic hybrids were produced.

COMMERCIAL APPLICATIONS:

In 1997, world shrimp farming produced 660,200 MT with crop value exceeding \$4 billion. Nearly all of this production depended on use of wild shrimp stocks, which are unstable in supply, contaminated with serious shrimp diseases and not adapted to modern culture systems. Development of a superior commercial shrimp by hybridization represents a substantial commercial opportunity based on modern breeding technology.

FY 98 Phase 1 Award Winner

TOPIC: 8.4 Ocean Science

SUBTOPIC: 8.4.2SG Aquaculture: Developing and Improving Marine Species Culture

TITLE: Evaluation of a Prototype Water Reuse System for Indoor Production of Marine Shrimp

FIRM: Seafood Systems, Inc.
3450 Meridian Rd.
Okemos, MI 48864

PRINCIPAL INVESTIGATOR: Russell A. Allen
517-347-5537

AWARD AMOUNT: \$48,285.90

ABSTRACT:

Shrimp imports to the U.S. are by far the single biggest contributor to the seafood portion of the U.S. balance of trade deficit. Seafood Systems, Inc. proposes to evaluate its indoor marine shrimp production system designed to show that commercial quantities of *Penaeid sp.* shrimp can be produced at competitive costs with shrimp produced from outdoor pond shrimp production systems. The prototype system design embraces: 1) commercial viable capital and operating costs, 2) production facility located away from environmentally sensitive coastal areas, 3) reduction or elimination of aquatic effluents, 4) bio-security, 5) year-round shrimp production, and 6) production of high quality, fresh shrimp for the U.S. market. Phase 1 research will evaluate the performance of the production system at stocking densities required for commercial success. Data will be recorded on shrimp growth and survival, water quality, and feed performance over a five month grow-out period. Positive results from Phase 1 work will lead to Phase 2; operation and evaluation of a commercial size pilot facility for marine shrimp production.

COMMERCIAL APPLICATIONS:

The success of Phase 1 and Phase 2 of this project will provide the data and documentation necessary for the implementation of a U.S. commercial marine shrimp farm project capable of producing large quantities of high quality, fresh marine shrimp for the U.S. market on a year round basis, will provide new technical employment opportunities, and will lead to the reduction of U.S. shrimp imports.

FY 98 Phase 1 Award Winner

TOPIC: 8.4 Ocean Science

SUBTOPIC: 8.4.5SG Sensor Technologies for Measuring Microbiota

TITLE: Micro-Radiometer/Fluorometer for Ocean Sensing

FIRM: Poulos Technical Services, Inc.
7 Waterbury Court
Allentown, NJ 08501

PRINCIPAL INVESTIGATOR: Arthur T. Poulos, PhD
609-259-5710

AWARD AMOUNT: \$49,405

ABSTRACT:

Recent efforts to develop systems to monitor aquatic ecosystems have focused on optical instrumentation which can collect instantaneous data over a wide range of spatial/temporal scales. It has been demonstrated that optical data can provide relevant information on the physical and chemical environments and the biological communities in a non-intrusive manner. The potential of using these techniques for a variety of applied management needs is large, but is hindered because in-water spectral measurements are costly and the instrumentation is cumbersome. The development of compact, inexpensive systems would greatly expand how recent advances in hydrological optics may be applied. To this end, this proposal intends to develop a submersible radiometer/fluorometer in which a microspectrograph is the principal optical component of the system. The system will be small, self-sufficient, and have low power requirements, all appropriate for deployment in an Autonomous Underwater Vehicle. The system would provide high resolution spectral data (7 nm resolution) covering the visible wavelengths of light. This Phase 1 project will also characterize the dynamic range and stability of the instrument in controlled laboratory conditions, sunlight conditions, and sea-water mesocosm tanks.

COMMERCIAL APPLICATIONS:

Water-based applications include: real-time oceanographic measurement in moorings, buoys, Roving Autonomous Vehicles and profiling CTDs; aquaculture monitoring of noxious cyanobacteria and algal blooms, e.g. in catfish farming; and municipal water quality management. Spin-off applications of portable microspectroscopy include: graphics colorimetry; dental color matching; and food safety.

FY 98 Phase 1 Award Winner

TOPIC: 8.4 Ocean Science

SUBTOPIC: 8.4.6SG Alternative Technologies to Ballast Water Exchange

TITLE: Development of a Shipboard Ultrasonic Ballast Water Sterilizer (SUBS)

FIRM: Oceanit Laboratories, Inc.
1100 Alakea Street, 31st Floor
Honolulu, HI 96813

PRINCIPAL INVESTIGATOR: Robert E. Bourke
808-531-3017

AWARD AMOUNT: \$50,000

ABSTRACT:

The transportation and introduction of non-indigenous species in ship ballast water has created substantial economic and environmental impact throughout the world. The present control method of choice is the exchange of ballast water at sea. This practice is time-consuming, potentially dangerous, and is not 100% effective. Researchers around the world are investigating various methods to sterilize or filter ballast water. Our unique method proposes to kill planktonic organisms within the intake manifold piping using strong pulses of ultrasound. High intensity ultrasound causes lethal damage through the formation and collapse of microbubbles within the soft tissues of entrained organisms. Previous attempts utilizing this strategy were unsuccessful, probably due to the type and pattern of sound generators that were being used. We propose to line the lumen of a pipe with piezoelectric film that will transform the entire length of pipe into one long sound generator. The resulting sound field will create a series of rolling sound pressure waves that will cause lethal microbubble formation in any entrained organism. This project proposes to construct a section of 10" pipes lined with piezoelectric film and test its efficiency on a variety of cultured planktonic marine organisms.

COMMERCIAL APPLICATIONS:

Existing and impending U.S. and international legislation are requiring increasing regulation of ballast water discharge from ships of foreign origin. Effective demonstration of this control method would be met with immediate international interest. Development of a commercial shipboard product would have a profound impact on shipping operations and the environmental health of ports and harbors world wide.

FY 98 Phase 1 Award Winner

TOPIC: 8.4 Ocean Science

SUBTOPIC: 8.4.7A A Microbial Sampler for Deep-Sea Research and Discovery

TITLE: Device for the Uncontaminated Collection of Multiple Microbial Samples from Submarine Hydrothermal Vents.

FIRM: McLean Research Laboratories, Inc.
Falmouth Technology Park
121 Bernard E. St. Jean Drive
E. Falmouth, MA 02536

PRINCIPAL INVESTIGATOR: John D. Billings
508-495-4000

AWARD AMOUNT: \$59,908

ABSTRACT:

In response to DOC solicitation 8.4.7A SUBTOPIC: "A Microbial Sampler for Deep-Sea Research and Discovery" we are submitting a proposal for the detailed engineering design on a Compact Microbial Sampler (CMS) that will obtain six uncontaminated microbial samples from deep-sea hydrothermal vents and other aquatic ecosystems. The device will be autonomous and miniaturized so that sampling may be readily conducted using manned submersibles, Remotely Operated Vehicles (ROV's), or Autonomous Underwater Vehicles (AUV's). The entire device will occupy one cubic foot of volume or less and will be composed of three modular elements: A) A sterilizable manifold accommodating 6 sampling modules that are each composed of a series of stackable filter units and/or containers that are assembled for collection of water or particulate samples according to user needs. B) An electromechanical module that is composed of a sample distribution valve and microgear pump for fluid handling operations, and a Tattletale 8-based electronic controller/data recorder. C) A sterilizable nozzle and associated umbilical that will permit uncontaminated sampling of the environment by manipulator arm or by direct mounting on the vehicle. A temperature probe will be incorporated into the nozzle to permit continuous measurement of temperature at sample site during sampling.

COMMERCIAL APPLICATIONS:

This instrument involves a relatively optimistic commercial market. The challenge of a new ramification of science will be provided. We expect application by multidisciplinary sciences including all areas of oceanography, bacteriology and geochemistry. Furthermore, when the extremophiles exploration develops applications presently unrelated including pharmaceuticals may very well benefit from the use of this technology.

FY 98 Phase 1 Award Winner

TOPIC: 8.6 Quality Assurance

SUBTOPIC: 8.6.2T Quality Management and Education

TITLE: Student-Centered Educational Quality Assessment Systems

FIRM: Intelligent Automation, Inc.
2 Research Place, Suite 202
Rockville, MD 20850

PRINCIPAL INVESTIGATOR: Jacqueline A. Haynes
301-590-3155

AWARD AMOUNT: \$75,000

ABSTRACT:

Intelligent Automation, Inc. will develop the Student-Centered Educational Quality Assessment System (SCEQAS) a suite of Internet/Intranet-based tools to assist public schools serving students K-12 in conducting internal, on-going assessment providing student-centered learning experiences that enhance the personal, social, emotional, and academic growth of each individual student. The focus of assessment will be based on the Malcolm Baldrige National Quality Award Education Pilot Criteria (1995). Our focus in Phase 1 will be on the criteria outlined in Section 5.0, Educational and Business Process Management. IAI will collaborate with the Dallas School District, of Dallas, PA, where the initial research and pilot of the prototype tools will be implemented. Our approach to identifying elements of quality in education programs is to examine the "fit" between goals for *individual* students, the programs provided to them, and the results achieved in moving *each individual student* toward his/her goals. This approach is an extension of a multi-disciplinary process used for many years to ensure provision of appropriate educational services to students with disabilities. The underlying assumption is that a school is successful if each of its students is successful, and that tools and methods which measure the success of individual students can be used effectively to provide continuous, internal guidance in development increasing levels of educational quality.

COMMERCIAL APPLICATIONS:

We expect that the Student-Centered Educational Quality Assessment System will be marketed to schools and school districts seeking to improve the quality of educational opportunity offered to students, by using the Malcolm Baldrige Quality Award Educational Pilot Criteria for internal assessment. SCEQAS embodies the view that education results when all students make progress toward individual goals. SCEQAS will also lead to new commercial software for development of Individualized Educational Programs and Service Agreements for students with disabilities and other special needs.

FY 98 Phase 1 Award Winner

TOPIC: 8.7 Advanced Technology Program

SUBTOPIC: 8.7.1T Technologies for Large Area Electronic Materials and Devices

TITLE: 3-D Printing of Opto-Electronic Components on Flexible Substrates

FIRM: Gemfire Corporation
2471 East Bay Shore Road, Suite 600
Palo Alto, CA 94303

PRINCIPAL INVESTIGATOR: Dr. Nigel Cockroft
650-849-6800

AWARD AMOUNT: \$75,000

ABSTRACT:

The technique of screen printing has been demonstrated to be of practical benefit in numerous engineering applications. Over the past two decades, these benefits have been widely recognized by the electronics industry, as evidenced by the flourishing field of screen-printed thick-film electronics. Multilayer circuits are now manufactured by the sequential deposition of conductive and resistive paste patterns and the deposition of solder bumps and epoxies to secure precisely mounted components. We propose to apply these advanced screen printing methods to large-area opto-electronic applications. In Phase 1, we will endeavor to demonstrate the feasibility of screen printing three-dimensional optical components on a flexible substrate using electroformed stencils, where feasibility is defined as being able to print fine-pitch 3-D optical features of precise dimension *and* being able to print a second set of features over the first without damaging either. In Phase 2, the remaining processes needed to manufacture functional devices on a flexible polymer display substrate will be developed and demonstrated for an application of major commercial importance.

COMMERCIAL APPLICATIONS:

The ability to screen printing 3-D opto-electronic components on thin, flexible substrates would provide a powerful new way of manufacturing low-cost, large-area integrated optics. Used in conjunction with existing electronic printing capabilities, the proposed method could greatly accelerate the emergence of large-area opto-electronic devices. The technology is anticipated to enable numerous unexpected applications in thin-film electronics.

FY 98 Phase 1 Award Winner

TOPIC: 8.7 Advanced Technology Program

SUBTOPIC: 8.7.2T Learning Technologies

TITLE: Natural Language Navigator for Internet and Other Browsers

FIRM: Ergo Linguistic Technologies
2800 Woodlawn Drive, Suite 175
Honolulu, HI 96822

PRINCIPAL INVESTIGATOR: Dr. Philip Bralich
808-539-3920

AWARD AMOUNT: \$75,000

ABSTRACT:

This application proposes a Phase 1 SBIR project to demonstrate the feasibility of using our NLP tools to develop a learner centered and learner paced Internet browser plug-in based on the NLP. This project will investigate the ability of our current NLP tools to be adapted to navigators in general through the demonstration of command and control abilities based on NLP for one particular Internet browser (Microsoft's "Internet Explorer") and the operating system associated with it. Specifically, this project will use our current NLP command and control tools to write a learner centered NLP user interface as a plug-in to allow the user to interact with the Internet with a minimum of knowledge of computers and of these applications. This NLP browser plug-in will significantly reduce the amount of computer training and program specific training that is required to allow a user to interact with the Internet.

COMMERCIAL APPLICATIONS:

In addition to the value of the increased ease of use for operating systems and navigators that is made possible by this NLP technology, it is clear that this technology will have a variety of areas of application. In fact, these NLP navigation tools can be easily ported to other navigators and operating systems to ease the burden of training and the need for experience that is often associated with new users. This is especially true in areas where sophisticated and non-user friendly systems are in use.

FY 98 Phase 1 Award Winner

TOPIC: 8.8 Electronics and Electrical Engineering

SUBTOPIC: 8.8.1T/A Characterization Techniques for Silicon on Insulator Materials

TITLE: Statistical Process Control of Electrical Parameters for SIMOX SOI

FIRM: IBIS Technology Corporation
32 Cherry Hill Drive
Danvers, MA 01923

PRINCIPAL INVESTIGATOR: Dr. L. P. Allen
978-777-4247

AWARD AMOUNT: \$74,978

ABSTRACT:

Growth in integration and power consumption levels of integrated circuits and the increase in portable and remote electronics applications have stimulated significant efforts in the area of low power electronics. Use of silicon-on-insulator (SOI) is a primary approach to simultaneously achieve increased circuit density, reduced power consumption, and improved performance in a cost effective manner. A significant aspect regarding the end user implementation of SOI substrates is the lot-to-lot reliability obtained from the SOI supplier, especially with regard to the background doping (N_B) of the top silicon layer. An opportunity exists to carefully search for, statistically process, develop testing methods for and correlate parameters of a new thin buried oxide (BOX) SIMOX manufacturing process in order to determine factors which contribute to the variation of B, P in the silicon layer of SIMOX SOI substrates. The Phase 1 will establish new applications of electrical conductivity measurements for identification and reduction of contamination sources in SIMOX SOI processing via SPC methods. The Phase 2 research and development will concentrate on the contamination reduction and an implementation of low B SOI substrates for fabrication in gate oxide integrity testing. The research effort may lead to SEMI standards for SIMOX contamination specifications.

COMMERCIAL APPLICATIONS:

The nation may expect to benefit from a new application of electrical characterization for reduced contamination in SIMOX SOI with a United States manufacturing base. Advanced SOI CMOS circuitry with improved gate oxide integrity will result.

FY 98 Phase 1 Award Winner

TOPIC: 8.8 Electronics and Electrical Engineering

SUBTOPIC: 8.8.9T *In-Situ* Composition Measurements of Quaternary Semiconductors

TITLE: *In-Situ* Composition Measurements for InGaAsP Quaternary Films Grown by MOCVD

FIRM: Spire Corporation
One Patriots Park
Bedford, MA 01730-2396

PRINCIPAL INVESTIGATOR: Peter C. Colter
781-275-6000

AWARD AMOUNT: \$74,948

ABSTRACT:

This SBIR Phase 1 project aims to develop an *in-situ* monitoring system for real-time composition measurement during growth of InGaAsP quaternaries by metalorganic chemical vapor deposition. We propose to use spectroscopic ellipsometry (SE) as a wafer sensor and ultrasonic sensors to monitor source material concentrations. SE provides energy gap and growth rate whereas ultrasonic sensors offer an estimate of alloy composition and growth rate. Our innovation is to develop a statistical model to correlate data from both sensors to determine alloy composition and growth rate in real-time.

In Phase 1, Spire will show feasibility of the proposed method by growing a series of lattice-matched InGaAsP/InP superlattices with simultaneous monitoring of the film's optical constants and of source material flows to the reactor. Quaternary composition will be determined *ex-situ*, allowing an after-the-fact demonstration of the method using real-time data. Then the data from the sensors will be correlated with process variations to develop a statistical model for the alloy composition and growth rate. In Phase 2, the technique will be further developed and, if possible, simplified, to arrive at a complete system including monitoring equipment and required materials databases, and measurement and control algorithms.

COMMERCIAL APPLICATIONS:

Development of an *in-situ* monitoring system for growth of quaternaries would significantly improve yields and reduce costs for advanced optoelectronic devices. Laser diodes for telecommunications and for high power applications represent an immediate application for this technology.

FY 98 Phase 1 Award Winner

TOPIC: 8.8 Electronics and Electrical Engineering

SUBTOPIC: 8.8.10T In-Situ Resistivity Measurements During Epitaxial Growth of Semiconductors

TITLE: In Situ Resistivity Measurement During Epitaxial Growth of Semiconductors Using MM Waves

FIRM: TLC Precision Wafer Technology, Inc.
1411 West River Road, North
Minneapolis, MN 55411

PRINCIPAL INVESTIGATOR: Vladimir Sokolov
612-341-2795

AWARD AMOUNT: \$75,000

ABSTRACT:

Manufacturing high performance semiconductor epitaxial wafers by MBE or OMVPE requires precision doping and layer thickness control to obtain optimum device and circuit performance. The wafer sheet resistivity is a key calibration parameter that indicates these variables are correct in the final wafer structure. The current approach for monitoring this parameter is to measure the sheet resistivity ex situ on special calibration wafers. This entails extra loading and unloading of wafers through the lad locks and generally results in production delays and lower product wafer throughput.

MM-waves can be used to probe the wafer's sheet resistivity inside the growth chamber with instrumentation entirely outside the chamber. This capability will streamline the production process while providing superior performance and reproducibility of the epitaxial wafers at reduced cost and higher throughput. Objectives for Phase 1 include demonstration of this technique on a bench setup and determining the sensitivity of the measurement scheme. The bench setup includes focusing a mm-wave beam onto a semiconductor wafer and measuring the free-space reflection coefficient which is related to the wafer's sheet resistivity. In Phase 2 the technique is to be applied to actual in situ measurements using an experimental growth chamber.

COMMERCIAL APPLICATIONS:

With successful completion of Phase 1 and 2, the mm-wave sensor will be ready for commercialization by working with and transferring the measurement technique to manufacturers of MBE and OMVPE equipment.

FY 98 Phase 1 Award Winner

TOPIC: 8.8 Electronics and Electrical Engineering

SUBTOPIC: 8.8.13T High Temperature Superconducting Programmable Voltage Standard

TITLE: High Temperature Superconducting Programmable Voltage Standard

FIRM: Conductus, Inc.
969 West Maude Avenue
Sunnyvale, CA 94086-2802

PRINCIPAL INVESTIGATOR: Stuart T. Berkowitz
408-523-9439

AWARD AMOUNT: \$74,991

ABSTRACT:

Joseph voltage standards working at 4 K produce the ultimate in accuracy for dc voltage measurement. A version using high temperature superconductivity would extend the range of applications. We propose to fabricate Josephson junction arrays for high temperature superconducting Josephson voltage standards. A NIST design will be modified for Conductus's new interface engineered junction process. This process relies on a modified superconductor surface rather than a deposited barrier. This junction process has a large selectable range in junction properties, while having among the tightest parameter spreads for high temperature superconducting junctions. In addition to the new junctions, coplanar waveguides transitions, termination resistors and capacitors will be fabricated on the chip. These chips will then be delivered to NIST for evaluation.

COMMERCIAL APPLICATIONS:

Successful implementation of this technology will allow a significant cost reduction from current voltage standards. In addition, the voltage could be programmable, which would extend the range of applications to the calibration of analog-to-digital converters and digital-to-analog converters.

FY 98 Phase 1 Award Winner

TOPIC: 8.9 Manufacturing Engineering

SUBTOPIC: 8.9.5T Virtual Manufacturing Metrology

TITLE: Virtual CNC with Performance Error Modeling

FIRM: MentorLink
301 Prelude Drive
Silver Spring, MD 20901

PRINCIPAL INVESTIGATOR: Donald M. Esterling
301-593-6232

AWARD AMOUNT: \$74,993

ABSTRACT:

A unique, real-space oriented solid model system will be used in conjunction with a Kinematic error model to create a virtual CNC. This virtual CNC will emulate performance characteristics using error data obtained from CNCs in use in industry. The virtual CNC will meet the very stringent requirements of industrial clients regarding processing speed and model accuracy. Easy-to-use analysis tools will be provided to facilitate acceptance and application of error model results by shop floor personnel.

COMMERCIAL APPLICATIONS:

Current error model data can be voluminous, complex to understand and difficult to put into practice by shop floor personnel. For the first time, these users will have a simple Go/NoGo tool to determine if a specific CNC machine can manufacture a part to specified quality standards with a particular NC part program.

FY 98 Phase 1 Award Winner

TOPIC: 8.9 Manufacturing Engineering

SUBTOPIC: 8.9.6T Internet Based Manufacturing

TITLE: Internet-based Commerce Using Autonomous Agents

FIRM: Intelligent Automation, Inc.
2 Research Place, Suite 202
Rockville, MD 20850

PRINCIPAL INVESTIGATOR: Kutluhan Erol
301-590-3155

AWARD AMOUNT: \$75,000

ABSTRACT:

The innovation detailed herein is our use of software fine-grained autonomous agents to provide a near-optimal, reactive, self organizing system to facilitate supply chain integration and Internet-based commerce. For DoD acquisition, the time from start to finish for manufacture of a system is often two years, while the hands-on production time is often less than 5% of that time. The Work in Process (WIP) is very costly. Companies like Gateway report a reduction in cost of 10% by manufacturing computers to order rather than stocking computers. The savings is reduction of WIP. Our innovations offer improved production, the ability to customize manufacturing to each customer's preferences, plus other advantages detailed in the proposal.

IAI has been working for four years on building scheduling and resource allocation systems using our fine-grained autonomous agents. Our agents represent each entity within the system, such as machine tools, people, jobs, fixtures, etc. Our agents effectively create an "agent marketplace" in which they bid and negotiate to arrive at commitments of products and delivery schedules which achieve locally optimal solutions. The schedules and resource allocations which result from this system are an emergent property of the interaction of these agents. The systems we have built using this concept are reactive, self-organizing, robust, and runs on any number of available computers networked together by a local area network. The current AARIA system runs only on computers connected by a local area network. The purpose of the work herein proposed is to expand the AARIA system to allow creation of a "virtual company" where the scheduling and resource allocation occurs between entities in different companies as well as within a single company.

COMMERCIAL APPLICATIONS:

Consumer demand and current computational capabilities are driving the manufacturing complex from mass production (where the manufacturer tells consumers what they can buy) to mass customization (where the customer tells the manufacturing complex what to

manufacture). We believe the Internet and our fine-grained agent technology provide powerful new tools for creating agile networks of supplies that are truly responsive to individual desires, while at the same time increasing the efficiency of production.

FY 98 Phase 1 Award Winner

TOPIC: 8.9 Manufacturing Engineering

SUBTOPIC: 8.9.7T Next Generation Process Exchange Tools and Applications

TITLE: Software Tools for Process Specification and Exchange

FIRM: STEP Tools, Inc.
1223 Peoples Avenue
Troy, NY 12180

PRINCIPAL INVESTIGATOR: John Valois
518-276-2277

AWARD AMOUNT: \$74,395

ABSTRACT:

This project will develop specification and prototype implementations of software tools for facilitating exchange of process oriented data using the Process Specification Language. These tools will be based on the EXPRESS 2 and EXPRESS-X languages currently under development as part of the STEP data exchange standard. We intend to exploit the key new features of these languages in order to support the requirements in the PSL; namely, the dynamic modeling capabilities of EXPRESS 2 and the mapping capabilities of EXPRESS-X. We will also leverage the existing STEP standard framework by investigating the feasibility of extensions to the STEP implementation methods (file and programming API based exchange) and the EXPRESS-G language for graphical presentation of process exchange models.

COMMERCIAL APPLICATIONS:

Potential commercial applications of this research are, first and foremost, a set of programming tools for facilitating the development of process data exchange using PSL and accepted international standards. Furthermore, it is expected that as these tools gain acceptance, they will be used by independent software vendors to create additional commercial applications.

FY 98 Phase 1 Award Winner

TOPIC: 8.9 Manufacturing Engineering

SUBTOPIC: 8.9.7T Next Generation Process Exchange Tools and Applications

TITLE: A Framework for Building PSL Translators

FIRM: Knowledge Based Systems, Inc.
1408 University Dr. East
College Station, TX 77840

PRINCIPAL INVESTIGATOR: Florence Tissot
409-260-5274

AWARD AMOUNT: \$74,998.59

ABSTRACT:

Because processes are present in all aspects of an organization, most decision-making applications and implementation solutions deal with specification, representation, and manipulation of process-related information. In recent years, several projects have addressed the problem of sharing process-related information among heterogeneous software systems. One of the most prominent projects is the Process Specification Language (PSL) headed by NIST. The success of PSL is dependent on its adoption as a standard by the commercial community. In this project, we propose to develop a framework for the development of PSL translators. This framework will make it easier and cheaper for commercial software companies to develop PSL translators. In Phase 1, we propose to obtain a detailed design for such framework and for PSL translators for three process-centered commercial applications. The framework will include a detailed methodology for building translators as well as a set of tools to support the automated use of the method. The translators and the architecture will be implemented in Phase 2 of this project, and will be released as commercial products soon after the completion of Phase 2. We anticipate high commercial demand for both the translators and the framework.

COMMERCIAL APPLICATIONS:

The framework that will be implemented in this project will provide key technology for the rapid and cost effective development of PSL translators, providing solid foundations for the adoption of PSL as a standard.

FY 98 Phase 1 Award Winner

TOPIC: 8.9 Manufacturing Engineering

SUBTOPIC: 8.9.11T Laser Tracker Virtual Instrument

TITLE: Development of a Virtual Laser Tracker Instrument

FIRM: New River Kinematics, Inc.
4767 Wurno Road
Pulaski, VA 24301

PRINCIPAL INVESTIGATOR: Robert Salerno
540-994-9320

AWARD AMOUNT: \$75,000

ABSTRACT:

The goal of this research project is to develop a virtual laser tracker software package capable of accurately estimating the uncertainty of laser tracker measurements in real-time. This requires a comprehensive method for modeling the propagation of measurement errors through the entire measurement process. To do this, New River Kinematics will develop a virtual laser tracker modeling toolkit. This toolkit will be capable of modeling component-by-component the relevant physical characteristics of any laser-tracker-like device. Parameter characterization techniques will be designed to fit the virtual laser tracker model to the performance of the actual device using numerical optimization techniques. The uncertainty of measurement coordinates will then be determined through simulation of various geometrical configurations using the virtual laser tracking model.

The virtual laser tracker provides a convenient and cost effective method for obtaining realistic coordinate uncertainty estimates. This will allow metrologists to test measurement geometries in software and design measurement configurations to reduce overall coordinate uncertainty.

Laser Trackers are quickly becoming an indispensable part of our nation's manufacturing base. For these industries to remain competitive and meet ISO 9000 and ISO Guide 25 measurement accreditation, an established coordinate uncertainty estimation method is an absolute necessity.

COMMERCIAL APPLICATIONS:

The software application resulting from this research will be directly applicable to commercial measurement systems. Metrologists will be able to quickly determine the realistic uncertainty with which they can measure parts. In addition, manufacturers may use this application to better design the laser tracker devices to reduce the measurement uncertainty of the device. Since the characterization of the device parameters is a necessary part of this work, the resulting model may be incorporated into the laser tracker control software to compensate the

measurements in real-time. This calibration process would greatly increase the accuracy of laser trackers in general since the model will be comprehensive and include many more parameters than previously modeled.

FY 98 Phase 1 Award Winner

TOPIC: 8.10 Chemical Science and Technology

SUBTOPIC: 8.10.1T A Novel Atomizer for Reference Spray Combustion Facility

TITLE: Electrostatic Atomizer for Precision Droplet Size and Dispersion Control

FIRM: CFD Research Corporation
215 Wynn Drive
Huntsville, AL 35805

PRINCIPAL INVESTIGATOR: Matthew E. Thomas
205-726-4800

AWARD AMOUNT: \$74,970

ABSTRACT:

CFD Research has demonstrated that charged injection atomization provides dynamic and precise droplet size and distribution control capable of providing numerous combustion technology breakthroughs. This project will demonstrate electrostatically charged high temperature fuel injection technology that produces different a priori specified droplet sizes and velocity distributions and generates droplet velocities to 30 m/s. The Phase 1 prototype will be customized for installation into NIST facilities and will include:

- (1) SPRAYTRON atomization technology capable of uniform droplet size control between 5-200 microns using conventional fuels at flows from 1-10 liters/hr;
- (2) an optional secondary injection environment with immediate commercial applications for higher flows; and
- (3) recommendations for NIST combustion chamber modifications to make it fully electrostatically compatible while further enhancing its utility to perform industrial research.

The Phase 1 deliverable atomizer will include three distinct passages; one electrostatically powered for low flows (1-10 liters/hr), a second for higher flows and the third for atomization/entrainment air. Phase 1 electrostatic atomization technical assessment will focus on applications in liquid waste incineration, automotive, power generation and propulsion. The Phase 2 fuel injection and combustion system deliverables will permit CFDR and NIST to support research activity for numerous military and commercial clients interested in utilizing electrostatically enhanced combustion during Phase 2.

COMMERCIAL APPLICATIONS:

Phase 3 commitments totaling \$450,000 - \$900,000 to retrofit existing product lines have already been obtained contingent upon Phase 1 and 2 success. Commitment potential from

nationwide combustion equipment manufacturers associated with waste incineration, stationary and propulsion gas turbines, fire protection, etc. easily exceeds \$10,000,000. In addition, numerous other opportunities exist in areas such as sea water desalinization, agricultural, diesel engine, paint spraying, powder coating gun industries, etc. to name a few.

FY 98 Phase 1 Award Winner

TOPIC: 8.10 Chemical Science and Technology

SUBTOPIC: 8.10.2T Strongly Coupled CFD Code for Modeling of Spray Combustion Systems

TITLE: Next Generation CFD Code for Spray Combustion Simulations

FIRM: CFD Research Corporation
215 Synn Drive
Huntsville, AL 35805

PRINCIPAL INVESTIGATOR: M.G. Girdharan
205-726-4800

AWARD AMOUNT: \$74,963

ABSTRACT:

In spite of major advances in CFD technology over the past two decades, simulation of practical spray combustion systems is still challenging due to difficulties in modeling multi-component fuels, droplet-turbulence and turbulence-combustion interactions, droplet deformation and breakup, soot and gaseous emissions, chemical kinetics, and large number of droplet samples needed for stochastic modeling. The proposed study will develop an advanced spray combustion code incorporating advanced physical models for the above phenomena in the context of solution-adaptive gridding and efficient parallel algorithms.

The Phase 1 effort will demonstrate the feasibility of such a code by coupling an advanced spray dynamics module with an existing unstructured reactive flow solver. Droplet tracking through polyhedral cells, droplet heat and mass transfer, droplet-turbulence interactions, droplet deformation/breakup, and multi-step kinetics will be addressed. This baseline capability will be validated against data on nonevaporating and evaporating sprays. An axisymmetric furnace simulation will be performed and compared with available data to assess accuracy and model deficiencies. In Phase 2, more detailed physics, solution-adaptive gridding and algorithm improvements will be pursued. Multi-component fuels will be modeled with properties estimated from SUPERTRAPP database. A soot model will be incorporated in the code and tested in conjunction with an existing nongray thermal radiation model and prescribed/Monte-Carlo pdf models for turbulence-combustion interaction. A variety of full-scale 3-D waste fuel furnace/incinerator simulations will be performed for extensive testing and validation. Prof. Aswani Gupta of the University of Maryland will contribute his expertise to this project as a consultant.

COMMERCIAL APPLICATIONS:

The computer code developed under this study will be used for the design and development of combustion chambers, furnaces, boilers and thrust generators. This code will also be used to

assess the performance, stability and durability of gas turbine and rocket engines. The packaged code will be marketed for use in evaporative cooling systems, particle separation systems, fire protection systems, chemical/process industries and particle/dust cleaning systems used in microelectronic applications.

FY 98 Phase 1 Award Winner

TOPIC: 8.10 Chemical Science and Technology

SUBTOPIC: 8.10.6T New Technology Detectors for Analytical X-Ray Spectrometry

TITLE: New Technology EDS Detectors for X-Ray Microanalysis

FIRM: Photon Imaging, Inc.
19355 Business Center Dr., Suite 8
Northridge, CA 91324

PRINCIPAL INVESTIGATOR: Dr. Jan Iwanczyk
818-709-2468

AWARD AMOUNT: \$75,000

ABSTRACT:

The goal of the proposed work is to develop a novel detector for analytical x-ray spectrometry having large active area, high-energy resolution and capable of operating at high counting rates. The proposed detector will be specifically designed for x-ray microanalysis to provide orders of magnitude advancement in the performance over conventional energy dispersive systems. The proposed detector will be composed of a small (4-element) array of novel x-ray drift detectors each capable of attaining electronic noise of 8 e rms at peaking times as fast as 90 ns allowing throughput rates as high as 2.5×10^6 per detector element. Importantly, the detector will not require cryogenic cooling to obtain this performance. The projected increases in the active area ($\sim 2 \text{ cm}^2$) and count rate capability ($\sim 1 \times 10^7$ cps) will allow shorter data collection times and lower exposure doses to the samples. These advances will have a remarkable impact on reducing the acquisition time for 2-dimensional compositional mapping and examination of biological samples sensitive to radiation damage.

Our overall objective for Phase 1 is to develop a closely spaced array of four 0.5 cm^2 detector elements. This will be sufficient to evaluate the detector against the targeted performance goals in terms of low dark currents, low noise, high efficiency, and high count-rate capability for x-rays. The prototype detectors in Phase 1 will be tested using standard spectroscopy electronics and an x-ray generator. In Phase 2 we will develop a prototype x-ray spectrometer for insertion into an electron microscope. The prototype will include the finalized detector array based upon the Phase 1 studies as well as integrated front-end electronics and specialized amplification and processing electronics in order to obtain the optimal specifications listed above. A specialized housing for the integrated detector/FET will be developed and deployed at NIST in one of the scanning electron microscopes.

COMMERCIAL APPLICATIONS:

The proposed new detectors will lead to significant performance improvements and lower cost systems. Elimination of the need for liquid nitrogen combined with the low power consumption x-ray analytical systems. These new devices will replace many existing detectors based on cryogenic Si(Li) and High Purity Germanium, used in many commercial (e.g., microanalysis, x-ray fluorescence, x-ray diffraction, medical imaging) and scientific (nuclear, high energy physics, synchrotron radiation experiments) applications. Other new applications are possible for use in hand-held, portable field instrumentation.

FY 98 Phase 1 Award Winner

TOPIC: 8.11 Physics

SUBTOPIC: 8.11.2T/A Bidirectional Ellipsometer for Surface Inspection

TITLE: Polarized Scatterimetry for Surface Inspection

FIRM: Spectral Technology & Innovative Research
6500 Hollister Avenue, Suite 210
Goleta, CA 93117

PRINCIPAL INVESTIGATOR: Samuel Pellicori
805-682-1922

AWARD AMOUNT: \$69,335

ABSTRACT:

A novel instrument is proposed that will enable rapid and precision inspection of highly polished material surfaces. Using "polarized scatterimetry" techniques, the surface topology, residual machining artifacts, and subsurface defects in materials can be quickly inspected in the manufacturing area. Thus, defects in substrates intended for mirrors, semiconductor microelectronics or magnetic storage media can be quickly detected and characterized. Unlike typical profilometers and atomic force microscopes which rely upon "point-contact" probing, this remote sensing instrument can inspect extended areas of material surfaces in the manufacturing line environment for high volume in-process quality control. Also, the compact and physically robust Polarized Scatterometer can detect and characterize surface contaminants and/or foreign matter particulates. More importantly, this instrument can perform conventional as well as these new unique quality control functions with significantly less hardware than conventional laboratory elipsometers.

Preselection of defect-free starting materials will significantly improve the manufacturing yields for products in the semiconductor, optics, and other technologies that depend upon micro-lithography and micro-machining for large scale integration (LSI) of complex parts. Thus, the production of such components as super-polished mirrors, semiconductor electronics, optical elements, video focal-planes and the like will benefit from higher quality, better yields, and lower cost through the implementation of the proposed instrumentation.

COMMERCIAL APPLICATIONS:

1. Characterizing materials to preselect those capable of producing flawless components for the microelectronic, optoelectronic, data-storage, and medical industries thereby affecting a significant cost savings for military and commercial markets.

2. Characterizing scatter and its sources in thin film coatings such as filters and mirrors, thereby permitting the development of lower scatter coatings that provide higher laser damage thresholds to be achieved. Wavelength Division Multiplexing (WDM) filters of sub-nanometer bandwidths require low scatter to achieve high efficiency and rejection.

FY 98 Phase 1 Award Winner

TOPIC: 8.11 Physics

SUBTOPIC: 8.11.6T/CC High Resolution Two-Dimensional Active Electronic Neutron Detectors

TITLE: High Resolution Neutron Imager

FIRM: Nova Scientific, Inc.
54 Main Street
Sturbridge, MA 01566

PRINCIPAL INVESTIGATOR: R. Gregory Downing
518-785-0991

AWARD AMOUNT: \$74,994

ABSTRACT:

This effort will develop more powerful and cost-effective active electronic neutron radiography imagers, utilizing a direct neutron detection scheme within a borated microchannel plate (MCP) coupled to a fast, pixelated electronic readout for real-time imaging. This novel neutron imager will offer a combination of high spatial resolution, large format (up to 8 inches square), and detection efficiency which will be superior performance to existing active electronic neutron detectors. For Phase 1, a 25 mm format neutron imaging device with electronic readout will be fabricated and fully tested using slow neutrons at NIST's research reactor, using 8 μ m square pore MCPs fabricated from a previously-developed borated lead glass material. Measurements will include limiting spatial resolution, detection efficiency for neutrons, dynamic range, and sensitivity to background gamma rays. The NIST tests will also include a comparison benchmark against the competing foreign neutron imaging devices. Assuming the Phase 1 demonstration of this small format neutron image is successful, the Phase 2 work will focus on assembling much larger 200 mm (8") square detector hardware capable of direct digital operation and thus full compatibility with image grabbers as well as off-the-shelf imaging software. Ultimately such imaging detectors could also be used for near-time tomography.

COMMERCIAL APPLICATIONS:

Neutron, radiography; non-destructive evaluation (NDE); neutron diffraction and scattering; nuclear materials inspection.

FY 98 Phase 1 Award Winner

TOPIC: 8.11 Physics

SUBTOPIC: 8.11.14T Liquid-Nitrogen-Cooled Electrical Substitution Radiometer

TITLE: Advanced Absolute Radiometers Using Superconducting Transition Thermometers

FIRM: CRI, Inc.
80 Ashford Street
Boston, MA 02134

PRINCIPAL INVESTIGATOR: Peter Foukal
617-787-5700

AWARD AMOUNT: \$75,000

ABSTRACT:

Recent work at NIST with superconducting transition thermometers suggests that substantial improvements may be achieved in detectivity of electrical substitution radiometers (ESR's) widely used as the most accurate absolute standards of high flux and irradiance. We propose here to carry out the research and development required to demonstrate that the reported advantages of SC transition thermometry can be translated into: (a) LN₂-cooled ESR's of comparable accuracy, but easier accessibility, than conventional, LHe-cooled instruments (and also more suitable for space-borne measurements); (b) LHe-cooled ESR's capable of improved detectivity and thus of greater usefulness in the aerospace industry. In this work we will work with vendors to determine whether SC transition temperature sensors of the required detectivity, achieved at NIST, can be constructed commercially. We will also seek to achieve the performance reported in the NIST work, and to develop five specific radiometer designs suitable for important practical applications. These designs are intended for construction and characterization in our Phase 2 work. CRI is the world's leading manufacturer of cryo-ESR's, and identifies domestic and foreign commercial markets of \$7-10M for this technology if the detectivity increase reported in the SC thermometers can be translated into a corresponding detectivity increase in practical radiometers.

COMMERCIAL APPLICATIONS:

Total commercial markets of \$7-10M in:

- (a) LN₂-cooled absolute detectors of light flux and irradiance of similar accuracy, but more widely accessible, than conventional LHe-cooled electrical substitution radiometers.
- (b) LHe-cooled, or mechanically cryo-cooled radiometers capable of much higher detectivity than conventional cryo-ESR's.
- (c) Also: LN₂-cooled pyrheliometers for NOAA or NASA monitoring of total and UV solar irradiance from space.

FY 98 Phase 1 Award Winner

TOPIC: 8.11 Physics

SUBTOPIC: 8.11.17T Platinum Silicide Photodiode Detectors for the Extreme Ultraviolet (Standards Quality)

TITLE: Silicon Photodiode EUV Transfer Standards with Platinum Silicide Front Window

FIRM: International Radiation Detectors, Inc.
2545 W. 237TH Street, Unit I
Torrance, CA 90505-5229

PRINCIPAL INVESTIGATOR: Dr. Raj Korde
310-534-3661

AWARD AMOUNT: \$63,317

ABSTRACT:

NIST has been using our 100% internal carrier collection efficiency silicon photodiodes with 60 Å oxynitride front window as transfer standards in 5 nm to 250 nm wavelength region for the past several years. These silicon photodiodes have significant cost and performance advantage over other types of transfer standards used by NIST in this wavelength range. However, quantum efficiency of these devices degrade by about a couple of percent after exposure to 10 eV photons with $10^{16}/\text{cm}^2$ fluence. Recognizing that the 60 Å oxynitride front window leads to exposure induced instability, diodes with platinum silicide (PtSi) front window leads to exposure induced instability, diodes with platinum silicide (PtSi) front window were fabricated recently. Stability tests performed at NIST and LBL showed that quantum efficiency of PtSi window devices did not change after exposure to 10 eV, 10^{16} photons/ cm^2 and 100 eV 10^{18} photons/ cm^2 respectively. This suggests that the PtSi front window devices have outstanding stability. In the presently proposed work we plan to extend this work to demonstrate fabrication of silicon diodes with PtSi front window suitable to be used as transfer standards. Fabrication of avalanche photodiodes with PtSi-n-type silicon Schottky barrier construction will be investigated during the Phase 2.

COMMERCIAL APPLICATIONS:

Other than their use as transfer standards in EUV, the developed diodes will be extremely useful in other areas of science and technology like plasma diagnostics, EUV/deep UV lithography and photorefractive and phototherapeutic keratectomy.

FY 98 Phase 1 Award Winner

TOPIC: 8.11 Physics

SUBTOPIC: 8.11.18T UV Fluorescence Imaging System for Spatially
Selective Identification of Radical/Molecules
Important to Silicon Wafer Processing

TITLE: Micromachining of High Performance Ultraviolet Array Detectors

FIRM: LEEOAT Company
2631 Colibri Lane
Carlsbad, CA 92009

PRINCIPAL INVESTIGATOR: Eli Wiener-Avnear
760-438-1439

AWARD AMOUNT: \$75,000

ABSTRACT:

In Phase 1 of the program, LEEOAT Company will develop and optimize the design and fabrication process of a high performance, stable, robust and cost-effective UV focal array detector and system, based on LEEOAT Company proprietary micromachining technology. The effort will also include a theoretical modeling of the expected detector and system performance (sensitivity, quantum efficiency, signal/noise, resolution, Modulation Transfer Function). On the basis of the theoretical results, the detector and system components will be optimized. Compatibility of the UV detector and system with present and future space and other commercial applications will be also evaluated in the optimization effort. LEEOAT Company will also estimate the cost/effort of the fabrication and testing of the detector and system to be performed in Phase 2 of the program.

COMMERCIAL APPLICATIONS:

The development of the cost-effective high performance miniaturized UV array imager will open a large window of opportunity for commercial, medical, and military applications. Estimate commercial market can exceed \$200M per annum.

FY 98 Phase 1 Award Winner

TOPIC: 8.12 Materials Science and Engineering

SUBTOPIC: 8.12.2T/A/ Software for Analysis of Acoustic Microscope Signals

TITLE: Digital Filtering Software for Analysis of Acoustic Microscope Signals

FIRM: Sonix, Inc.
8700 Morrisette Drive
Springfield, VA 22152

PRINCIPAL INVESTIGATOR: Michael F. Whalen
703-440-0222

AWARD AMOUNT: \$24,910.50

ABSTRACT:

Current research at NIST has proven that ultrasonic signals from a scanning acoustic microscope can be used to map residual stress patterns in engineering materials. Previously, no direct method existed for displaying stress. Knowing a materials residual stress is important in determining the integrity of that material, and how it may respond in service.

The existing NIST method relies on measuring the amplitude of shear waves produced by mode conversion from a defocused ultrasonic transducer. This method works well except for the fact that the return signals can be corrupted by an additional component of the longitudinal wave.

This proposal seeks to improve the usefulness of the NIST method of stress mapping by using digital filtering techniques to eliminate the unwanted longitudinal component of the ultrasonic waveform. Filtering techniques have a high probability of success since the shear wave component exists at about twice the frequency of the longitudinal wave.

In this Phase 1 effort, Sonix will: (1) design digital filters; (2) embed the filter algorithms into an existing acoustic microscope; (3) test the filtering algorithms on engineering materials provided; and (4) deliver and install a working prototype of the improved microscope software at the NIST facility in Gaithersburg.

COMMERCIAL APPLICATIONS:

Sonix has an existing customer base of several hundred acoustic microscope users. Upon successful completion of Phase 1, Sonix will poll its users to determine a marketing strategy. It is very likely that digital filtering capabilities added to the acoustic microscope will be a desirable upgrade feature to the system.

FY 98 Phase 1 Award Winner

TOPIC: 8.12 Materials Science and Engineering

SUBTOPIC: 8.12.7T/CC Process Monitoring and Control of Composites Processing

TITLE: Optical Fiber Devices for Composite Process Monitoring

FIRM: F&S, Inc.
P.O. Box 11704
Blacksburg, VA 24062-1704

PRINCIPAL INVESTIGATOR: Paige Furrow
540-953-4282

AWARD AMOUNT: \$74,921

ABSTRACT:

This proposed SBIR program will develop novel optical fiber devices and cost effective, rugged demodulation systems that utilize existing optical techniques for the control of composites processing. The techniques include fluorescence and Fourier Transform Infrared (FTIR) spectroscopy both of which have been developed and demonstrated at NIST using optical fibers. F&S has a history of: (1) developing innovative technologies in fiber optic sensors for harsh environments including process monitoring; and (2) producing off-the-shelf products for industry and government organizations. The F&S team is experienced, capable and motivated to move this exciting technology into their existing product line. F&S has recently constructed an additional facility to cooperatively transition research results into manufactured products with non-Federal commercialization funding pledged by private industry.

COMMERCIAL APPLICATIONS:

The integrated fiber optic multiplexed process monitoring system has immediate commercial interest for research institutions examining the processing of polymers. F&S also envisions immediate markets for fiber optic process monitoring equipment in the polymer processing industry and longer-term opportunities in the composite fabrication industry, specifically in applications requiring large composite structures.

FY 98 Phase 1 Award Winner

TOPIC: 8.12 Materials Science and Engineering

SUBTOPIC: 8.12.10T Software for Optimization of Ceramic Lapping and Polishing

TITLE: Modeling and Optimization of Abrasive Lapping

FIRM: Mohawk Innovative Technology, Inc.
437 New Karner Road
Albany, NY 12205

PRINCIPAL INVESTIGATOR: Hooshang Heshmat, Ph.D.
518-862-4288

AWARD AMOUNT: \$74,413

ABSTRACT:

The overall MiTi program will consist of an integrated analytical and experimental study as follows. The existing quasi-hydrodynamic powder lubrication equations will be modified under Phase 1 to account for the introduction of a liquid carrier. Since the quasi-hydrodynamic model has been used in the past to minimize wear, it is proposed that it herein be used in reverse to control and enhance the lapping process so as to yield desired geometries and surface roughness of the lapped surface. The analytical model established in Phase 1 will thus provide a guide for optimizing the lapping process and will be used to investigate the interface dynamics of the lapping process such as velocity profiles, pressures and temperatures. Key to the optimization will be the selection of material shapes and properties that will yield a shear strength for the slurry higher than that of the lapped surface. While the Phase 1 parametric studies will use estimated rheological characteristics of slurries, it is understood that experimental work is needed to establish the bulk properties of various slurries. Specifically the rheological properties need to be determined as functions of particle size and shape for several carrier fluids and abrasive particles, such as diamonds silicon carbides and others. Therefore an additional objective of Phase 1 will be to prepare designs of necessary modifications to test rigs used previously to characterize the rheological properties of fine powders. The conceptual test rig designs will provide the foundation for the Phase 2 detailed design, fabrication and test efforts.

COMMERCIAL APPLICATIONS:

Manufacturing provides a significant contribution to the United States economy, accounting for over 19 percent of the gross domestic product and approximately 65 percent of the total exports. As such, improving manufacturing processes through increased accuracies, reduced costs and/or reduced processing times can have a major impact on the international competitiveness of the U.S. industry. In many industry segments, considerable cost and time is added to end products in the finishing processes such as lapping and polishing. Lapping and polishing are particularly important to the optics industry and machine tool spindle manufacturers that require high precision and long life components.

FY 98 Phase 1 Award Winner

TOPIC: 8.12 Materials Science and Engineering

SUBTOPIC: 8.12.11T Device and Technique for Measurement of Thermal Conductivity of Ceramic Powders

TITLE: High-Temperature Thermal Conductivity Measurement of Ceramic Powders

FIRM: METSYS
P.O. Box 254
Millwood, VA 22646

PRINCIPAL INVESTIGATOR: Daniel Flynn
540-837-2186

AWARD AMOUNT: \$75,000

ABSTRACT:

It is proposed to develop an advanced apparatus for measuring the thermal conductivity of ceramic powders, and other loose-fill materials over the range of temperatures from room temperature to 1500 to 2500 °C, depending upon the particular material and its compatibility with other materials. The apparatus will have the capability to carry out measurements under controlled environments of air, selected gases, or vacuum, again depending upon material compatibility. The specific technical objectives of the Phase 1 development effort are to: develop performance criteria and specifications for the apparatus; review alternative measurement approaches, select the design, and refine it to the point where it can be subjected to detailed analysis; develop numerical and analytical models of the apparatus that will enable reliable prediction of apparatus performance and measurement accuracy as functions of the design parameters; study and analyze alternative approaches to the most crucial design features of the apparatus; and develop a detailed design, including construction drawings of the complete prototype apparatus to be built in Phase 2, and all instrumentation and software specifications.

COMMERCIAL APPLICATIONS:

The apparatus to be developed under this project will be of direct value to scientists and engineers who are involved in modeling thermal spraying of ceramic powders, chemical processing of ceramic powders, and fabrication of solid ceramics from consolidated powders. The apparatus also will provide critically needed data on the thermal conductivity of high-temperature thermal insulations used in a wide variety of industrial and military applications.

FY 98 Phase 1 Award Winner

TOPIC: 8.12 Materials Science and Engineering

SUBTOPIC: 8.12.13T Object-Oriented Development Environment of Intelligent Process Control Strategies

TITLE: A Methodology for the Specification of Complex Process Control Strategies

FIRM: Intelligent Computing Technologies, Inc.
6309 John Chisum Lane
Austin, TX 78749-1839

PRINCIPAL INVESTIGATOR: Robert W. Sumners
512-301-2444

AWARD AMOUNT: \$74,360

ABSTRACT:

Modern production systems are considered high assurance systems in that they must perform their function in a manner that satisfied specified critical properties. Studies have shown that a large portion of the most serious errors in safety-critical systems are caused by faulty or incomplete specification of a system's required operation. The objective of the proposed feasibility project is to investigate and develop a methodology and prototype software tool that can assist a control system designer in specifying required system operation. The methodology and software tool will: (1) assist in the system modeling; (2) assist in the control system definition; and (3) automatically generate the control system code. The software tool is the necessary apparatus that will be used to evaluate the methodology; in essence, the software tool will embody the methodology. The methodology will permit the modeling of the production system in an object-oriented fashion and will use techniques developed in the field of distributed artificial intelligence (*e.g.*, expert systems, fuzzy logic, *etc.*). The innovations of the proposed project derive from the novel merging of leading-edge research in the areas. An eventual product derivable from a potential follow-on Phase 2 project would have enormous commercialization potential.

COMMERCIAL APPLICATIONS:

The eventual product derivable from the proposed research would have enormous commercialization potential. Many modern production control systems have requirements for extremely complex behavior, with many interacting sub-systems and components, thus requiring methodologies similar to that proposed to assist production system designers. Existing tools do not provide facilities to assist the developer, analyze the specified control strategies, or automatically generate code from the behavior specifications. Lastly, a large number of production control systems are currently manually operated and are being converted to computer-based automatic control systems, thus providing a ready customer base.

FY 98 Phase 1 Award Winner

TOPIC: 8.13 Building and Fire Research

SUBTOPIC: 8.13.4T Low-Cost, Smart Vibration Sensors

TITLE: Low-Cost, Smart Vibration Sensors Utilizing CIFMEMS Technology and Postmolded-Plastic (PMP) Packaging

FIRM: Optical E.T.C., Inc.
3077-K Leeman Ferry Road
Huntsville, AL 35801

PRINCIPAL INVESTIGATOR: Dr. Jon Geist
301-774-7280

AWARD AMOUNT: \$74,995

ABSTRACT:

The feasibility of a very low-cost approach to producing smart vibration sensors will be investigated. The approach consists of: (1) fabricating integrated circuit wafers containing vibration sensor precursors and signal processing electronics at a commercial Application-Specific Integrated-Circuit (ASIC) foundry service in a completely standard CMOS process; (2) processing the completed wafers to convert the sensor precursors into functional sensors on chips suitable for postmolder-plastic (PMP) packaging; and (3) packaging the chips at a commercial PMP packaging service. Steps (1), (2), and (3) involve CIFMEMS, post-processing, and PMP technologies, respectively. These steps will be carried out (or simulated when appropriate) to produce functional vibration sensors with interface electronics co-integrated on a single chip in a PMP package. Post-processing procedures to make CIFMEMS and PMP technologies compatible without sacrificing the cost advantages of these technologies will be researched. Potential problems that significantly increase cost or reduce reliability will be identified, and potential solutions for implementation in a Phase 2 effort will be proposed.

COMMERCIAL APPLICATIONS:

There is a large, untapped market for very low-cost vibration sensors for shutting off malfunctioning air-conditioning compressors in commercial buildings to minimize the damage that is caused by running a malfunctioning unit. A break-through in sensor cost is needed to tap this market. The results of a successful completion of this project will be applicable to many other untapped sensor markets.

FY 98 Phase 1 Award Winner

TOPIC: 8.13 Building and Fire Research

SUBTOPIC: 8.13.5T Visualization of Building Information

TITLE: Visualization of Building Information

FIRM: Interface Engineering, Inc.
6542 S.E. Lake Road
Milwaukie, OR 97222

PRINCIPAL INVESTIGATOR: David Gessert
503-659-6394

AWARD AMOUNT: \$75,000

ABSTRACT:

Current computer fire design programs have several limitations that impair their usefulness in designing for fire safety in buildings and in developing performance-based fire codes. The alpha numeric input method the current methods use is time consuming and error prone. The opportunity that exists is to integrate the fire calculation engines with a drawing package that is "object oriented." So that, for example, specifications for a wall can be attached to the drawing of the wall. The geometric data takeoff can be "automated," greatly reducing the time required to simulate a building, and enabling the designer to do more "what-ifs" and move closer to an optimized design. There are three main ways to implement a software package that communicates with AutoCAD software: from within AutoCAD using AutoCAD's customization features; entirely from outside AutoCAD using only DXF files as input; and a mixed approach so that geometry is done within AutoCAD and visualization features are done outside AutoCAD. Likewise there are three ways to incorporate the Fire Model code: rewritten in C and called directly within AutoCAD; rewritten in C and called from a Microsoft Windows program; called with few or no changes in a DOS window from a Microsoft Windows program.

COMMERCIAL APPLICATIONS:

Fire models with a graphical interface and geometry interpreter would be faster to use, more accurate and more accessible, and therefor would have increased commercial value. The improved speed and accuracy of the software would mean that smaller jobs could be profitably modeled and more design iterations could be done on larger jobs. If fire models were more accessible, code agencies would be more willing to rely on predicted performance as a measure of a building's fire safety.

FY 98 Phase 1 Award Winner

TOPIC: 8.13 Building and Fire Research

SUBTOPIC: 8.13.11T Advanced Detection and Monitoring of Fires

TITLE: Low Cost Pre-Fire Detector

FIRM: Sensor Research and Development Corporation
5 Godfrey Drive
Orono, ME 04473

PRINCIPAL INVESTIGATOR: Ralph Chapman
207-866-0100

AWARD AMOUNT: \$75,000

ABSTRACT:

A detector sensitive to an impending fire, before the onset of smoke or flames, could help minimize fire-related losses. Hydrogen chloride (HCl) gas emanates from many materials at elevated temperatures prior to the formation of smoke, especially from polyvinyl chloride (PVC) used extensively in electrical wire insulation and in plumbing products.

A thin film semiconducting sensor developed at Sensor Research and Development Corporation (SRD) has been shown to be sensitive to HCl during testing using both dilute vaporized hydrochloric acid and heated PVC. The chemiresistive element response to HCl is ended. This feature, combined with the robustness of the materials from which it is constructed, suggests that the sensor is reliable and may be a good candidate for a commercially viable pre-fire detector.

In this Phase 1 effort, SRD intends to characterize an HCl sensitive chemiresistive detector for application as a pre-fire detector by quantifying the detector sensitivity and response time to HCl derived from a variety of heated materials under pre-fire conditions. A preliminary reliability test of three months duration will be conducted as part of the characterization.

COMMERCIAL APPLICATIONS:

The development of a pre-fire detector, one that warns of conditions indicative of an impending fire, will add an important capability to the arsenal of available fire detection and suppression technologies. Immediate commercial applications include the telecommunications industry, electrical instrumentation and control installations, and other areas with high value electrical wiring. Further applications may combine array type sensors with a pre-fire detector for enhanced performance of smart systems.

FY 98 Phase 1 Award Winner

TOPIC: 8.13 Building and Fire Research

SUBTOPIC: 8.13.12T Advanced Fire Suppression and Novel Suppression Concepts

TITLE: Development of Enhanced Performance Pulsed Flow Water MIST Fire Systems

FIRM: Hughes Associates, Inc.
3610 Commerce Drive, Suite 817
Baltimore, MD 21227-1652

PRINCIPAL INVESTIGATOR: Craig Beyler
410-737-8677

AWARD AMOUNT: \$75,000

ABSTRACT:

Recent fire tests of commercially available water mist systems have shown that water mist technologies have the possibility of either replacing current fire protection techniques no longer deemed environmentally acceptable or providing new answers to problems where traditional technologies have not been as effective as desired. Water mist systems are being actively considered for a variety of fire protection applications.

The proposed research will evaluate the feasibility of improving the performance of water mist fire suppression systems through the use of pulsed water flow. The Phase 1 research will include room scale testing of three generic water mist systems. These three systems will cover the range of spray characteristics produced by currently available water mist hardware. Parametric studies with extensive instrumentation will also be conducted. Information will be collected to serve as the foundation for the development of an extinction model which will be used as a design tool for real scale systems to be prototyped and tested in Phase 2.

COMMERCIAL APPLICATIONS:

It is anticipated that the innovation developed in this research will improve the performance of water mist systems by minimizing collateral damage, while reducing the cost, weight, and power requirements of the systems.

FY 98 Phase 1 Award Winner

TOPIC: 8.13 Building and Fire Research

SUBTOPIC: 8.13.12T Advanced Fire Suppression and Novel Suppression Concepts

TITLE: A Solid-Solid Hybrid Gas Generation Fire Suppression System

FIRM: Mainstream Engineering Corporation
Pines Industrial Center, 200 Yellow Place
Rockledge, FL 32955

PRINCIPAL INVESTIGATOR: Lawrence Grzyll
407-631-3550

AWARD AMOUNT: \$69,888

ABSTRACT:

This proposal addresses the development of a novel solid-solid hybrid gas generator fire suppression technology to replace the ozone depleting Halon 1301 for total flooding applications. Mainstream's solid-solid hybrid gas generator technology will result in the delivery of chemical extinguishing agents to the fire in addition to the inert gas agents. The technology will also result in the delivery of agents that are significantly cooler than the hot inert gases generated by conventional inert gas generators, which range from 1200°F to 2000°F. This technology has several advantages over state-of-the art gas generator fire suppression technology. First, the system will be significantly smaller and lighter than current gas generator systems because it results in chemical, in addition to physical, extinguishment of the fire. Second, the entire hybrid gas generator material is stored in a single storage vessel as a solid, compared to other hybrid systems which require a separate pressure storage vessel. Third, the hybrid gas generator material has acceptable atmospheric and toxicological properties, unlike other hybrid gas generator systems that use the agents HFC-227ea, HFC-236fa, or CF₃I.

COMMERCIAL APPLICATIONS:

Successful completion of the Phase 1 effort will result in the demonstration of Mainstream's hybrid gas generation fire suppression technology. The Phase 1 experiments will show that this technology is superior to other existing technologies in terms of system size, system weight, fire suppression effectiveness, and cost. The technology also has no environmental or atmospheric concerns, making it the ideal future technology for total flood fire suppression.

FY 98 Phase 1 Award Winner

TOPIC: 8.13 Building and Fire Research

SUBTOPIC: 8.13.14T Toxic Environmental Monitor for Fire Fighter and Research Use

TITLE: Deployable Sensor Array for Gases Relating to Fire Fighters

FIRM: BioAsyst, L.L.C.
12321 Middlebrook Road
Germantown, MD 20871

PRINCIPAL INVESTIGATOR: William Wiesmann
301-428-9818

AWARD AMOUNT: \$74,335

ABSTRACT:

In 1994 alone fire fighting services in the United States experienced 104 fire related deaths. Twenty-eight of these deaths were directly related to smoke inhalation or carbon monoxide (CO) poisoning. One of the causes of these fatalities may be the fire fighter having an inaccurate perception of his environment. Fires produce a variety of toxic gases, including carbon dioxide (CO₂) and CO. This introduces a dangerous situation in the event of a malfunction or the depletion of the fire fighter's self-contained breathing apparatus (SCBA). For these reasons, the development of a sensor system for monitoring CO₂, CO, and O₂ levels will enhance the safety and survivability of fire fighters. This system must be capable of tolerating the environment of a fire while still producing accurate results. Once the sensor data is acquired, it must be communicated to the fire fighters in a clear and understandable manner. Research must also be conducted to determine how long a fire fighter can remain in the environment. Data from the sensor array system will be used to provide the fire fighter with an accurate picture of their exposure and the duration of time, which they may safely remain in the environment.

COMMERCIAL APPLICATIONS:

The broad application of the remote hazard monitoring to the fire services, mining industry, and other high risk working environments accounts for a substantial market for this device. In the U.S. alone, there are over 33,000 separate fire departments, not counting U.S. government or military requirements. The absence of an available equivalent technology would ensure a significant market penetration in these communities.

FY 98 Phase 1 Award Winner

TOPIC: 8.14 Information Technology

SUBTOPIC: 8.14.1T Extending RBAC to Include Work Flow Properties

TITLE: Network Security Model for Work Flow

FIRM: Secure Computing Corporation
2675 Long Lake Road
Roseville, MN 55113

PRINCIPAL INVESTIGATOR: Dan Thomsen
612-628-2783

AWARD AMOUNT: \$74,957

ABSTRACT:

Historically, businesses have protected assets by mandating prescribed processes and individual responsibilities. Today, vital assets are stored and managed via information systems. Work flow technology, combined with an underlying role-based access control (RBAC) mechanism, is a promising solution for automatically controlling business processes and information assets.

Under this Phase 1 effort, we propose to extend RBAC to support workflow constraints. The RBAC model framework that we will start from has been developed on the DARPA Information Assurance Program here at Secure Computing. This innovative RBAC model includes an object-oriented approach to describing the permissions granted to roles. The model has an additional feature of enforcing complex conditions to be satisfied before access can be granted. It is by extending this feature of conditional access that we hope to enforce workflow policies.

Our objective is to present a solution that fits existing business practice and is easy to use. In addition to the enhanced RBAC model, we will produce a prototype graphical user interface (GUI) for specifying the workflow security policy by extending the RBAC prototype produced on the Information Assurance Program. The model and the tool will be demonstrated by specifying a sample workflow policy.

COMMERCIAL APPLICATIONS:

Secure Computing provides a wide family of high security products, including firewalls, web filtering software and authentication servers. One of the primary focuses is to provide centralized management of security components throughout the enterprise. Specifying and enforcing workflow policies accurately and easily is critical to enforcing complex business policies at several different locations. Secure Computing intends to incorporate the workflow technology developed under this program into its suite of network security products.

FY 98 Phase 1 Award Winner

TOPIC: 8.14 Information Technology

SUBTOPIC: 8.14.1T Extending RBAC to Include Workflow Properties

TITLE: Workflow-Enhanced Role-Based Access Control

FIRM: Knowledge Based Systems
1408 University Drive E.
College Station, TX 77840

PRINCIPAL INVESTIGATOR: Ronald Fernandes
409-260-5274

AWARD AMOUNT: \$74,991.89

ABSTRACT:

The absence of a unified access control across workflow elements and heterogeneous, autonomous, distributed information infrastructure elements of an enterprise leaves much to be desired for system administrators. While the former is generally viewed as process-centric, the latter is viewed as object-centric. The use of role based access control, a concept of mandating permissions to roles of the enterprise, allows both workflow processes and information processes to have a unified access control.

We propose to develop a Workflow-Enhanced Role-based Access Control (WERBAC) infrastructure to extend the RBAC framework model to include workflow concepts. WERBAC will be formally defined in terms of meta-models, rules and a specification language. We also propose to develop a Workflow-aware Multi-tier Client-server Code Generator (WMCCG) toolkit to automate the generation of workflow software from enterprise WERBAC and information/data models.

Implementing WERBAC in an enterprise will result in simplifying enterprise-wide authorization, and in a more secure information infrastructure environment. Besides demonstrating the advantages of the WERBAC infrastructure, the WMCCG tool kit has all the benefits of a RAD tool-generating applications that are faster, cheaper, easily maintainable, and more reliable, making Business Process Re-engineering highly effective.

COMMERCIAL APPLICATIONS:

The research will produce Rapid Application Development tools to implement business process reengineering solutions rapidly and reliably; thus government and industry can operate more profitably.

FY 98 Phase 2 Award Winner

TOPIC: 8.1 Atmospheric and Hydrological Sciences

SUBTOPIC: 8.1.5A Space Weather Industry

TITLE: Implementation of a Prototype System for Distributed Space-Weather Models and Applications

FIRM: NorthWest Research Associates, Inc. (NWRA)
14508 NE 20th Street
Bellevue, WA 98007-3713

PRINCIPAL INVESTIGATOR: James A. Secan
425-644-9660

AWARD AMOUNT: \$200,000

ABSTRACT:

Accurate and timely information about space weather has become essential for managing many technologies upon which our lives increasingly depend (e.g., television and radio communications, the Global Positioning System). A major limitation to accessing this information from both government and private sources is the lack of well-defined, standardized methods for accessing data and for running models (or applications) remotely over the Internet. Northwest Research Associates proposes to continue and extend development of the Space Weather Models and Applications Programs Interface (SwxMAPI) system begun under Phase 1 to address this problem. This is an open-architecture interface definition within which software tools (both open and proprietary) can be constructed to allow users to provide and request space weather data via the interface. In Phase 2, we will focus on extensions to the technology successfully developed and demonstrated during Phase 1, and will design and construct prototypes of additional tools to be used by private space-weather vendors to build space weather service products and services. The new tools will include Java-based components (Java Beans) that provide connectivity to the SwxMAPI tools and a network browser (SwxBrowser) that will serve as the basic tool on client systems for accessing SwxMAPI resources.

COMMERCIAL APPLICATIONS:

While the SwxMAPI specification will be open and freely available to the space weather community, NWRA will commercialize the implementation software modules of the SwxMAPI client, server, remote database agent, and application software components. Targeted customers are private space-weather product vendors and end-users in need of space-weather data or products. Commercial interest in these products is expected to swell as we move toward a time of maximum solar activity and increased use of, and reliance on, technologies impacted by space weather.

FY 98 Phase 2 Award Winner

TOPIC: 8.1 Atmospheric and Hydrological Sciences

SUBTOPIC: 8.1.6A Automated Airborne Measurements of Atmospheric Variables

TITLE: A Standard Lidar Interface for Wind and Aerosol Profiling From Commercial Aircraft

FIRM: Coherent Technologies, Inc.
655 Aspen Ridge Drive
Lafayette, CO 80026

PRINCIPAL INVESTIGATOR: Jerry V. Pelk
303-604-2000

AWARD AMOUNT: \$199,992

ABSTRACT:

Lidar systems offer considerable promise for the acquisition of atmospheric data with high spatial and temporal resolution from airborne platforms. Ground based lidar systems have been demonstrated that measure aerosols, water vapor, ozone, and winds. Airborne wind sensing lidar systems have been flown on several military and research aircraft.

Applications for airborne lidar data include weather forecasting, verification of observations from other sensors, such as radiosonde and satellite observations, and atmospheric research. Commercial aviation would benefit by avoiding atmospheric turbulence and wind shear detected by airborne lidar, promoting safety and comfort.

Commercial aircraft provide a cost effective platform for the collection of atmospheric data. Airborne lidar systems would measure and process wind profiles in real-time as the aircraft fly their commercial routes. The wind profiles would be communicated to ground stations using existing commercial aircraft digital telemetry systems.

CTI proposes to develop a Standard Lidar Interface that permits minimal modification of the aircraft, and offers no impact to flight operations. In the Phase 2 program, detailed designs of an airborne lidar wind profiling system will be developed.

COMMERCIAL APPLICATIONS:

The development of this commercial aircraft lidar interface facilitates the commercial application of lidar technologies to commercial aircraft. Commercial applications include the collection of atmospheric variables for meteorological and scientific uses. Other applications include sensing potentially hazardous wake vortices, wind shear, and downburst conditions. Detection of clear air turbulence and favorable wind conditions during cruise will promote airline passenger and crew safety, and aircraft operational efficiency.

FY 98 Phase 2 Award Winner

TOPIC: 8.1 Atmospheric and Hydrological Sciences

SUBTOPIC: 8.1.7A Omni-Directional Cloud Height Indicator

TITLE: Omni-Directional Cloud Height Indicator

FIRM: Oceanit Laboratories, Inc.
1100 Alakea Street, 31st Floor
Honolulu, HI 96813

PRINCIPAL INVESTIGATOR: Robert W. Deuel
808-531-3017

AWARD AMOUNT: \$199,895.17

ABSTRACT:

Phase 1 efforts clearly demonstrated the feasibility of an omni-directional cloud height indicator (3-D CHI). Phase 2 efforts will produce a complete prototype 3-D CHI that is compatible with an upgrade to the present Automated Surface Observing System (ASOS) CHI. Phase 2 efforts will complete the design and construction a prototype using a Vaisala CT-25K ceilometer. The hardware for a pan/tilt mount will be procured according to the design requirements and analysis performed under Phase 1 efforts to fabricate a complete system. Feedback mechanisms and controller drivers would be designed and integrated with the mount hardware. The necessary instructions for mount control, data processing, and system monitoring would be developed, implemented and assembled into a field configuration for incorporation into an ASOS unit. This prototype of an SOS compatible hardware package would then be field tested at a local airport alongside a standard ASOS CHI. A final report of all activities and test results would be prepared and submitted at the conclusion of the effort.

COMMERCIAL APPLICATIONS:

The CHI upgrade developed in this Phase 2 would be marketed to all current ASOS customers. ASOS locations currently listed exceed 900 sites. In addition, there are over 4000 public-use airports and over 12,000 private-use airports in the United States, which together represent a significant potential market. Thus, the application of this research could lead to the manufacture and installation of several thousand units, which would involve a major positive impact upon the local economy.

FY 98 Phase 2 Award Winner

TOPIC: 8.2 Ocean Observation Systems

SUBTOPIC: 8.2.1A Operational Ocean Instrumentation and Measurement Systems

TITLE: Optical Water Level Sensor

FIRM: Ciencia, Inc.
111 Roberts Street
Suite K
East Hartford, CT

PRINCIPAL INVESTIGATOR: Dr. Salvador M. Fernandez
860-528-9737

AWARD AMOUNT: \$200,000

ABSTRACT:

Development of an optical water level sensor is proposed to solve some of the problems and limitations of current sounding tube/protective well acoustic sensors. A prototype of an in situ sensor will be built and evaluated at a NOAA water level station where its performance will be benchmarked against that of an existing acoustic sensor. The proposed optical technology offers a number of potential benefits: by using light instead of sound, temperature gradient effects on the measurement are obviated. Furthermore, the proposed system eliminates the need for a sounding tube, protective well and associated temperature sensors, and does not require having any part of the system under water. These features would provide several advantages which include: More robust performance with accuracy not affected by temperature effects; considerably reduced installation and maintenance costs, small size with great mechanical simplicity and structural stability; easier installation with greater flexibility in siting; high immunity to fouling and freezing problems; not subject to attenuation of high-frequency water level signals; improved performance in terms of range, resolution and sampling rate; and greater overall cost-effectiveness.

COMMERCIAL APPLICATIONS:

Water level sensing for sea and lake level measurements as well as a number of industrial fluid level sensing applications including process monitoring, tank gauging and leak detection. Other applications include a variety of optical ranging applications in surveying and construction.

FY 98 Phase 2 Award Winner

TOPIC: 8.4 Ocean Science

SUBTOPIC: 8.4.1A Underwater Visual Imaging System

TITLE: An Underwater, Video-Based, Stereoscopic Imaging and Measurement System

FIRM: Waterjet Technology, Inc.
21414 68th Avenue South
Kent, WA 98032

PRINCIPAL INVESTIGATOR: (Peter) H.-T. Liu
253-872-1925

AWARD AMOUNT: \$199,887

ABSTRACT:

Phase 1 feasibility of developing a PC-based stereoscopic imaging and measurement system (SIMS) for underwater applications has been demonstrated. During Phase 1, a wealth of information on the state-of-the-art PC technologies has been collected for Phase 2 R&D. Critical issues such as corrections for image distortions, advantages of stereoscopic imaging over the monoscopic counterpart, in situ camera calibration, and improvement for 3-D measurements have also been adequately addressed. Two field-worthy SIMS prototypes capable of *real-time stereoscopic display* and *on-line on-demand 3-D measurements* will be developed, fabricated, and tested in Phase 2, with emphasis on incorporating advanced PC technologies into the hardware design, software development, and their integration. They will be available for deployment during NURP-sponsored field expeditions and for demonstrations toward Phase 3 commercialization. To maximize the resolution, the cameras will be equipped with "on-the-fly" zooming and tilting capabilities. Because adding color to the images will enhance the stereoscopic quality of the 3-D images, the SIMS will be color ready, pending on the meeting of the requirement for real-time stereoscopic display technically and cost effectively. The SIMS is definitely not application limited because it will work with a variety of images acquired by visible, IR, X-ray, acoustic and magnetic devices.

COMMERCIAL APPLICATIONS:

The SIMS, deployable on ROVs and by divers, will have high market potential for underwater navigation, positioning, inspection, and measurements. Mounted on robotics, SIMS will be suitable for underwater and nuclear clean-up jobs (surface preparation, construction, maintenance, and repair). Using images acquired with cameras (visible and IR), X-ray, ultrasonic, and magnetic devices, the SIMS will be readily applied to the biomedical, aerospace, military, and entertainment sectors.

FY 98 Phase 2 Award Winner

TOPIC: 8.4 Ocean Science

SUBTOPIC: 8.4.2.SG Aquaculture: Water Reuse & Effluent Treatment Systems

TITLE: Development of an Extremely Low Water-loss Recirculating Floating Bead Filter for Biofiltration and Solids Capture on Recirculating Marine Filters

FIRM: Aquaculture Systems Technologies, LLC
P.O. Box 15827
New Orleans, LA 70175

PRINCIPAL INVESTIGATOR: Douglas G. Drennan II
504-837-5575

AWARD AMOUNT: 94,000

ABSTRACT:

The shortfall in worldwide marine fisheries landings are aiding the development of aquaculture technologies on many fronts. However, the interest and use of recirculating systems for production of marine organisms have lagged behind their freshwater counterparts. A floating bead filter which is corrosion resistant (no metal parts), operating with minimal water loss, and can be automated to backwash with minimal electronics is needed to enhance the economic feasibility of marine recirculating systems. Phase 1 proved that the drop filter concept works. Phase 2 will address the scientific issues and conduct system evaluations needed for the production of a commercial-scale MRBF that is a compatible with projected integrated marine system designs based on airlift or pumped recirculation.

COMMERCIAL APPLICATIONS:

This project proposes to finalize the marine, recirculating, floating bead filter (MRFB) that will meet an existing demand. Successful completion of the project will result in commercial production of MRBF models to support established filter markets that are currently used in shrimp maturation, hybrid striped bass breeding and fingerling production, redfish fingerling production, soft blue crab production, shellfish purging and holding systems, baitfish production, and lobster holding/display units. Future markets can be expected to develop in support of developing areas such as the saltwater ornamental, summer flounder, pompano or grouper production.

FY 98 Phase 2 Award Winner

TOPIC: 8.4 Ocean Science

SUBTOPIC: 8.4.4SG Molecular and Immunological Probes

TITLE: Simplified DNA Probe Identification of Harmful Algal Species

FIRM: Saigene Corporation
1725 220th Street, SE, #104
Bothell, WA 98021

PRINCIPAL INVESTIGATOR: Paul V. Haydock
(425) 485-5377

AWARD AMOUNT: \$199,703

ABSTRACT:

The dinoflagellate, *Alexandrium*, is responsible for paralytic shellfish poisoning episodes encountered worldwide. Geographically restricted ribotypes of *Alexandrium* have been previously discovered through sequence analysis of the large subunit ribosomal RNA. The purpose of this project is to develop a DNA probe-based sandwich assay for the detection of three different ribotypes of *Alexandrium*, the three ribotypes being the North American, the Temperate Asian, and the Western European. In Phase 1, capture and signal oligonucleotides were developed for each geo-specific group and tested on lysates of representative organisms from each group. Artificial nucleic acid targets were developed for assay development and manufacturing quality control. Hybridization conditions were optimized for sensitivity and specificity. Preliminary field tests using natural water samples prove the efficacy of the test. In Phase 2, methods to enhance the sensitivity of the assay will be explored. In addition, sample preparation will be investigated with the object of making the procedure more user-friendly. Quantitative curves will be developed for estimating the abundance of these organisms in water samples. More extensive field testing will be performed at three different sites to test the various improvements in the assay, and a test kit will be developed for commercialization.

COMMERCIAL APPLICATIONS:

Harmful algal species are a worldwide concern leading to illness and death in both humans and marine life, and can have severe negative economic effects. Under this proposal, a rapid, easy-to-use test will be developed for certain toxin producing species of *Alexandrium*. This assay will have broad commercial application in early identification and localization of toxigenic species in coastal waters to alert monitoring agencies. Shellfish and finfish farmers, shipping industries, and state monitoring agencies will benefit from the use of this test.

FY 98 Phase 2 Award Winner

TOPIC: 8.4 Ocean Science

SUBTOPIC: 8.4.6SG Electronic Still Camera for Small Underwater Vehicles

TITLE: Automated Imaging and Mapping System for AUV

FIRM: Desert Star Systems
761 Neeson Road, #9
Marina, CA 93933

PRINCIPAL INVESTIGATOR: Marco Flagg
(408) 384-8000

AWARD AMOUNT: \$198,559

ABSTRACT:

Precision underwater mapping is an important requirement of projects ranging from wreck surveys and environmental impact studies to mine clearing operations and marine science projects. Small Autonomous Underwater Vehicles (AUV) are potentially capable platforms to conduct such surveys. In Phase 1, we implemented and tested an automated imaging and mapping system (AIMS), for AUV. This system combines electronic image capture, with image compression, storage and acoustic positioning. The Phase 1 work proved the validity, indeed the power, of the concept. AIMS gives AUV strong survey capabilities, allowing them to move around a site to systematically build an image map.

In Phase 2, we will take the next step: Rather than "patching together" a less than optimum design from standard components, we will build an architecture that is optimized for automated survey work. Consisting of a set of neatly stacked electronic boards and modular software libraries, this VISION architecture will support the speedy construction of customized survey systems. Systems will be small, will consume little power and will be inexpensive. The first VISION system will be for AUV - yet this flexible design is just as useful for ROV work and survey applications in the air, on land and in space.

COMMERCIAL APPLICATIONS:

VISION's first application and market will be AUV based survey systems. Yet, the VISION architecture is designed to support survey and image capture applications in any environment. Potential commercial applications include high-resolution ROV imaging and survey systems, automated aerial survey from drones or manned craft, automated long-term visual observation of marine habitats, military battlefield surveillance and survey, planetary surveys (space exploration), etc. As with our versatile Dive Tracker™ system before, there may also be many applications that are not yet imagined.

FY 98 Phase 2 Award Winner

TOPIC: 8.6 Quality Assurance

SUBTOPIC: 8.6.2T Quality Management and Health Care

TITLE: Algorithms for Health Care Quality Management and Outcomes Assessment

FIRM: Barron Associates, Inc.
1160 Pepsi Place, Suite 300
Charlottesville, VA 22901

PRINCIPAL INVESTIGATOR: B. Eugene Parker
804-973-1215

AWARD AMOUNT: \$199,133

ABSTRACT:

The research findings of the Phase 1 study demonstrated consistent superiority of health care outcome prediction algorithms developed by Barron Associates, Inc. (BAI) relative to that of other directly-comparable scoring systems. Advantages of the BAI approach include its generic nature, allowing BAI's tools and capabilities to be leveraged by any and all vendors of health care informatics, and the fact that the outcome prediction algorithms can operate with standard patient discharge abstracts in common use today (e.g., UB-92, discharge data). Use of such standardized records offers the advantages of wide reproducibility and the fact that *no* additional expense is required for the coding of illness. This unburdens health care providers from the task of creating more complex codes and reports, and should be deployable at every echelon of medical care. These are important attributes for minimizing costs and maximizing efficiency of health care process improvement and enhancement systems.

The proposed Phase 2 effort will further refine these algorithms and then validate them on more extensive databases than was possible in Phase 1. In particular, multiple large heterogeneous databases will be used in Phase 2 to validate the algorithms and to use such results to initiate Phase 3 commercialization with one or more health care information providers. Initial relationships are in place to effect a smooth transition of the new algorithms into commercial practice.

COMMERCIAL APPLICATIONS:

The requirement to improve existing quality assurance/process enhancement programs is inherent in all health care delivery systems. In addition to assessing quality of patient care, an accurate grading system for stratifying patients on the basis of illness severity can lay a vital role in acute care management, patient triage decisions, outcome comparisons, reimbursement justifications, and injury prevention efforts.

FY 98 Phase 2 Award Winner

TOPIC: 8.7 Electronics and Electrical Engineering

SUBTOPIC: 8.7.3T Compact Photoconductive-based Sampling System with Electronic Sampling Delay

TITLE: Compact Photoconductive-based Sampling System with Electronic Sampling Delay

FIRM: OptoElectric
9810 Kentsdale Drive
Potomac, MD 20854

PRINCIPAL INVESTIGATOR: Chi Lee
301-469-6924

AWARD AMOUNT: \$199,722

ABSTRACT:

Critical issues associated with the design of a rugged, compact “real-time” sampling system using photoconductive switches as the signal generator and sampler will be investigated. The design concept is based upon an optoelectronic equivalent time sampling principle developed by the Principal Investigator. It involves first the phase locking of the temporal waveform to be measured to the optical pulses and subsequent sampling of the locked waveform. The photoconductive switches are used both as optical-microwave mixer and sampler. The optical-microwave intermixing process generates a low frequency replica of the high frequency waveform to be sampled. The frequency ratio of these two waves is the time expansion factor. Since there is no electro-mechanical moving part involved, the sampling is done at a fast rate. The record acquisition time of 10 μ s per sweep can be achieved. Other issues concerning electronic sampling delay, epoch time, number of sampling points per epoch, resolution time, photoconductor carrier lifetime, sensitivity, signal-to-noise ratio, dynamic range, etc., will also be investigated. Because of the success of the Phase 1 research, we propose in Phase 2 to build a laboratory prototype pulse parameter testing instrument demonstrating the operation principle of the equivalent time sampling. This prototype instrument will meet most requirements as specified in Subtopic 8.7.3T.

COMMERCIAL APPLICATIONS:

Success of the research will lead to the commercial pulse parameter test instrument that is rugged and compact. It can perform the “real-time” characterization of high speed/high frequency signals with the following features: adjustable epoch time ranging from 200 ps to 100 ns; variable number of sampling points per epoch up to a few thousand points; record acquisition time 10 μ s per sweep; sampling aperture $\leq 5 \mu\text{V Hz}^{-1/2}$; photoconductor responsivity $\geq 1 \text{ A/W}$; and 2^{12} bits per full scale reading.

FY 98 Phase 2 Award Winner

TOPIC: 8.7 Electronics and Electrical Engineering

SUBTOPIC: 8.7.9T Joseph Digital to Analog Converter

TITLE: High Accuracy Digital-to-Analog Converter Based on Processing Magnetic Flux Quanta

FIRM: HYPRES, Inc.
175 Clearbrook Road
Elmsford, NY 10523

PRINCIPAL INVESTIGATOR: Alex Kirichenko
914-592-1190

AWARD AMOUNT: \$199,916

ABSTRACT:

HYPRES proposes to develop single-flux quantum digital-to-analog converter (DAC) integrated modules suitable for an ac Josephson Voltage Standard. The DAC modules will be able to generate 1 volt waveforms with frequencies from dc to 1 MHz and 10 volt waveforms with frequencies from dc to 30 kHz. The principal DAC circuits have been successfully demonstrated during Phase 1 of this project. In Phase 2, we will develop an optimized 20-bit DAC superconducting chip and a multi-chip cryoprobe for combining 20 chips into a full system. We will also develop a PCI-bus room-temperature interface and a 100 MHz reference signal generator based on a commercially available stable (rubidium) generator. The project will culminate with the demonstration of the DAC integrated module within HYPRES' voltage standard system.

COMMERCIAL APPLICATIONS:

The development of the quantum mechanically accurate digital-to-analog converters for dc and ac voltage standards is expected to provide an advantage in calibration of dc and ac reference standards and digital voltmeters, characterization of commercial digital-to-analog and analog-to-digital converters, and digital generation of waveforms with low spur content for radar applications. The ac-dc voltage standard based on the proposed DAC will lead to the drastic reduction of complexity and cost of room-temperature electronics. It will place the standard within reach of a much larger customer group worldwide.

FY 98 Phase 2 Award Winner

TOPIC: 8.8 Manufacturing Engineering

SUBTOPIC: 8.8.12T Software and Error Analysis for 2-D Grid Calibrations

TITLE: Algorithms, Software and Procedures for Self-calibrating 2D High-precision Stages

FIRM: Interconnect Technologies Corporation
P.O. Box 4158
Mountain View, CA 94040-0158

PRINCIPAL INVESTIGATOR: Dr. Michael Raugh
415-964-5958

AWARD AMOUNT: \$199,987

ABSTRACT:

At present, neither measurement standards nor accredited algorithms and procedures exist for calibrating high-precision 2D stages used in semiconductor metrology and manufacturing. It appears that self-calibration is required for calibrating them accurately. Until now, it has proved difficult to devise self-calibration algorithms and to verify their accuracy. Phase 1 exhibited a simple self-calibration algorithm that was proved accurate theoretically and through use of realistic simulated data and NIST laboratory data. Phase 1 also featured a formulation of stage self-calibration as an optimization problem, enabling straightforward use of numerical-analysis techniques for constructing accurate and efficient algorithms. If successful in Phase 2, this formulation will be exploited to develop an algorithm capable of using lattice-symmetric grids with less exacting procedures, to yield accuracy better than that of any algorithm known today. The algorithm will counteract cascading errors typical of self-calibration techniques and allow the use of data taken at periodic intervals to progressively refine the accuracy of a calibration over time. The simulation program prototyped in Phase 1 will be developed further as a means of generating realistic synthetic measurement data for measuring and comparing the accuracy of any 2D self-calibration algorithms.

COMMERCIAL APPLICATIONS:

The semiconductor industry is manufacturing computer chips with up to thirty layers of circuitry and hundreds of millions of transistors. And the density and complexity of chip designs keeps increasing, compelling the need for accurately calibrated lithography and stepper stages. Self-calibration software will be essential for obtaining the required accuracy, hence the commercial prospects for excellent.

FY 98 Phase 2 Award Winner

TOPIC: 8.8 Manufacturing Engineering

SUBTOPIC: 8.8.14T Interfaces to Manufacturing Resource Planning

TITLE: A STEP/CORBA Framework for Integrating Manufacturing Specifications with ERP

FIRM: Renaissance Engineering, Inc.
First National Plaza, Suite 1414
Dayton, OH 45402

PRINCIPAL INVESTIGATOR: Dan Z. Sokol
937-224-1414

AWARD AMOUNT: \$199,829

ABSTRACT:

While much of the data involved in product and order definition has been captured in standard electronic structures such as IGES and EDI, material and process specifications are still handled as amorphous, paper-based documents. The use of manual, text-based specifications is an extremely labor-intensive and time-consuming process. Specifications are an integral part of the product and order definition effort and the lack of integration between specification content and MRP/ERP is a major obstacle in achieving an agile manufacturing enterprise.

As a result of Phase 1 research, Renaissance Engineering (with the assistance of the Industrial Technology Institute) successfully created a conceptual design for a manufacturing specification application server which leverages STEP and CORBA technologies. During Phase 2, the Project Team proposes to: (1) develop STEP-compliant translator for import/export of spec data; (2) create a CORBA-based manufacturing specification application server; and (3) develop prototype of linkage between CORBA/STEP and ERP software. Instead of treating the design requirements in specifications a simple textual narrative, the proposed approach recognizes that specifications are an integral part of product data and product data exchange.

COMMERCIAL APPLICATIONS:

The numerous industries which have their processing, inspecting, and testing controlled by specifications are extremely interested in using tools that access specifications in an intelligent, computerized format. These industries include materials, castings, forgings, aerospace, automotive, pharmaceuticals, and chemicals. This effort could "jump-start" an entire industry related to providing tools for the computer-assisted analysis of specifications requirements.

FY 98 Phase 2 Award Winner

TOPIC: 8.9 Chemical Science and Engineering

SUBTOPIC: 8.9.7T Mid-Infrared Light Source for CRD Spectrometer

TITLE: Light Source for Cavity Ring-Down Spectrometer

FIRM: Aculight Corporation
11805 North Creek Parkway South, Ste. 113
Bothell, WA 98011

PRINCIPAL INVESTIGATOR: Dr. Charles Hamilton
425-482-1100

AWARD AMOUNT: \$199,976

ABSTRACT:

Cavity Ring-Down Spectroscopy (CRDS) is developing into a precise tool for measuring gaseous contaminants in ultrahigh vacuum and other environments. In order to make this a commercially viable technique, inexpensive laser sources which provide tunable, narrowband output in the mid-IR spectral region are required. Currently there are no commercial lasers available with these properties in a small, easy to use instrument. In this Phase 2 program, Aculight proposes to build and deliver a CW diode-pumped optical parametric oscillator (OPO) based on the new nonlinear material periodically poled lithium niobate (PPLN) for CRDS.

In Phase 1, the attributes of both pulsed and CW OPO's were investigated with regard to producing a cost-effective, single frequency mid-IR source for CRDS. The results of this work identified the CW diode-pumped architecture as that which offers the best performance at the lowest cost with the highest commercial payoff. This approach will develop an inherently stable and inexpensive device producing a tunable, 5MHz bandwidth, 10mW cw laser source for CRDS. A market study conducted to evaluate the commercial potential for a narrowband CW OPO source estimated the total unit volume to be up to 14,000 units/year if cost goals can be met.

COMMERCIAL APPLICATIONS:

Commercial applications of a narrow-band CW, tunable mid-IR source include: spectroscopy, gas detection, combustion diagnostics and seed sources for pulsed mid IR OPO's.

FY 98 Phase 2 Award Winner

TOPIC: 8.10 Physics

SUBTOPIC: 8.10.2T Analysis Software for Near-field Optical Microscopes

TITLE: Analysis Software for Near-field Optical Microscopes

FIRM: Field Precision
P.O. BOX 13595
Albuquerque, NM 87192

PRINCIPAL INVESTIGATOR: Stanley Humphries, Jr.
505-296-6689

AWARD AMOUNT: \$199,549

ABSTRACT:

The near-field scanning optical microscope (SNOM) can supply information on the shape and electrical properties of surfaces with nanometer resolution. The quantitative interpretation of images is challenging because of the difficulty of electromagnetic field solutions in the near-field limit. We propose to supply software to aid in this analysis. The finite-element programs will generate three-dimensional near-field scattering solutions in the time and frequency domains. They faithfully replicate free-space boundary conditions through the use of matched absorbing layers and the distributed source technique. The computational efficiency of the method enables sophisticated three-dimensional simulations on standard personal computers. Systems properties are defined through a universal mesh generator that handles arbitrary user-specified geometries. The software package includes extensive post-processing tools and special analysis utilities for SNOM applications. The well-documented programs are designed to be learned quickly so they will be of immediate use to microscopy researchers.

COMMERCIAL APPLICATIONS:

The software handles both the near- and far-field limits. In addition to microscopy, applications include microwave devices, materials testing, consumer electronics, hyperthermia treatment and electromagnetic compatibility. Accessible programs to handle 3D electromagnetics on personal computers would impact university research and product development in small business. The mesh generator can also be applied to solution packages for electrostatics, magnet design and thermal transport.

FY 98 Phase 2 Award Winner

TOPIC: 8.11 Materials Science and Engineering

SUBTOPIC: 8.11.2T Characterization Requirements for Modeling
Consolidation of Non-Spherical Powders

TITLE: Characterization of Consolidation of Non-Spherical Powders

FIRM: MATSYS, Inc.
6800 Versar Center, Suite 275
Springfield, VA 22151

PRINCIPAL INVESTIGATOR: Dr. Tony F. Zahrah
703-256-0550

AWARD AMOUNT: \$199,974

ABSTRACT:

“Press and sinter” of low-cost, irregular shape powders is the most cost-effective compaction process for component manufacturing for the consumer market. The die filling operation depends on the method of powder delivery into the die cavity. The current state of technology relies on gravity feeding. As a result of gravity feeding and feed shoe motion during the die filling, the packing density varies from one location to another within a component. The variation in density during the filling operation is amplified during the pressing operation resulting in component distortion and other defects during the delubing and sintering operations. We propose to develop a powder delivery system for die filling and characterize the early stage of consolidation of non-spherical powders to improve the cold compaction and sintering operations, expand the use of this low-cost approach to new applications, and further the development of process models to enable simulation of powder metallurgy manufacturing for the consumer market, especially the automotive industry. These new capabilities will enable the introduction of low-cost, high performance PM parts into the automotive market for critical components such as Class 9 gears and gerotors which require substantially greater precision and minimum variation in properties from lot-to-lot.

COMMERCIAL APPLICATIONS:

The first major beneficiary of this technology is the conventional PM industry, especially the automotive segment. In addition, the applications of this technology are numerous and widespread. Processing environments dealing with a wide variety of particulate materials and especially fine powders, including ceramics, composites, food, pharmaceuticals and cosmetics, are potential candidates. This technology also provides a less expensive and attractive alternative to slurry-based processing technologies.

FY 98 Phase 2 Award Winner

TOPIC: 8.11 Materials Science and Engineering

SUBTOPIC: 8.11.11T/A Technologies for Large Area Electronic Materials and Devices

TITLE: Next Generation Electrode Technology for Optimized Large-Area Electrochromic Windows

FIRM: SAGE Electrochromics, Inc.
501 Hoes Lane, P.O. 278, SUITE 208
Piscataway, NJ 08854

PRINCIPAL INVESTIGATOR: Hermann Volltrauer
908-445-3300

AWARD AMOUNT: \$200,000

ABSTRACT:

In this Phase 2 program, SAGE Electrochromics, Inc. will leverage its successful Phase 1 feasibility study to replace the indium doped tin oxide (ITO) transparent conductor (TC) with a dereflected silver-based thin-film stack. Significant cost savings achieved by replacing the ITO will enhance the competitiveness of electrochromic (EC) windows in the global marketplace. Other benefits include the ability to tune the reflected color and maximize the photopic transparency by altering the materials properties and varying layer thicknesses. The outermost layer of the stack, the low permeability capping layer, improves yields during processing by retarding the ingress of moisture and contaminants.

Phase 2 goals are to: (1) assure the durability of TC materials and the EC device by optimizing deposition parameters and then conducting accelerated and direct exposure testing under a variety of simulated and actual environmental stresses; (2) optimize the device optical properties by first modeling the performance of the TC stack and then fabricating composite structures and complete devices for spectral characterizations; and (3) insure that EC devices with the new structure can be manufactured at low cost by building prototypes, assessing processing problems, and instituting corrective measures that will facilitate scale-up in the commercialization phase.

COMMERCIAL APPLICATIONS:

Electrochromic glazings will have a tremendous impact on the architectural glass industry by allowing building occupants and owners to electronically control the shading of their window glass, anywhere from clear to darkly tinted. This dynamic solar control offers significant energy saving and comfort benefits. The proposed research will open the possibility for EC windows to be price-competitive with existing static solar control windows with mechanical blind systems, enabling broad market penetration and giving the U.S. an advantage in capturing global architectural glass markets, which are projected to exceed \$5 billion. EC glazings will also find application in transportation windows (for safety and comfort) as well as a number of speciality applications.

FY 98 Phase 2 Award Winner

TOPIC: 8.12 Building and Fire Research

SUBTOPIC: 8.12.7T Sweating Thermal Conductive Performance
Apparatus for Evaluation of Fire Fighter Protective
Clothing

TITLE: New Methods for Evaluating Thermal Performance of Protective
Clothing for Fire Fighters

FIRM: KTECH Corporation
901 Pennsylvania NE
Albuquerque, NM 87110

PRINCIPAL INVESTIGATOR: Ned R. Keltner
505-268-3379

AWARD AMOUNT: \$199,918

ABSTRACT:

In Phase 1, a new Thermal Inertia Block Sensor (TIBS) and two new test fixtures were developed. TIBS used a glass-ceramic material which stimulates the heating response of skin within 20%. Preliminary evaluations were made of moisture and compression effects on heat transfer in protective clothing and thermal properties; data analysis used parameter estimation and inverse heat conduction codes.

In Phase 2, a second general TIBS will provide more accurate measurements of heat transfer using another glass-ceramic material with properties even closer to human tissue. Platinum resistance thermometers will be used to measure temperature instead of thermocouples; this will provide capabilities for effectively calibrating or checking individual sensors. Mounting the test fixtures in load frames will provide accurate compressive loading.

Graphical Programming software will be used to develop an integrated sensor, data acquisition, and data analysis system. Digital filtering algorithms will be developed for rapid analysis of TIBS data.

Detailed evaluations of moisture and compression affects will use the upgraded sensors and test fixtures. The effects of laundering and the potential for burn damage due to stored energy will be evaluated. Radiant protective performance tests will be used to develop ratings and provide data for burn damage estimates.

COMMERCIAL APPLICATIONS:

An integrated thermal inertia block sensor-software package will be developed to replace the copper calorimeter currently used in thermal protective performance test fixtures. A sensor-

test fixture-data acquisition package will be offered to fire services for nondestructive field evaluation of new and used clothing as part of their selection, care, and maintenance programs. For protective clothing suppliers and research laboratories, both test fixtures and the sensors will be packaged with a data acquisition system and the specialized thermal analysis code.

FY 98 Phase 2 Award Winner

TOPIC: 8.13 Computer Systems

SUBTOPIC: 8.13.4T Composing Security Policies

TITLE: Composing Security Policies

FIRM: VDG, Inc.
6009 Brookside Drive
Chevy Chase, MD 20815

PRINCIPAL INVESTIGATOR: Serban Gavrilă
301-975-4343

AWARD AMOUNT: \$199,994

ABSTRACT:

The overall objective of this research project is to develop a general administrative method and tool for the definition and composition of access control policies in centralized and distributed computer systems. Specifically, the administrative method and tool will allow the definition and composition of a family of separation-of-duty (SoD) policies in role-based, access control (RBAC) systems. The method and tool will be general in the sense that it will allow the definition and composition of a family of SoD policies on different RBAC systems. Although most commercial computer systems support applications that implement their own security policies that are composed with the underlying operating system policy, the result of such composition, and that of composing different application policies with each other within the same systems, is generally unknown and can often lead to security exposure. To date, the systematic definition of families of application-oriented security policies, such as separation of duty, and their composition remains an elusive goal because of the lack of practical methods and administrative tools. The growing commercial interest in this area is largely due to the wide-spread recognition that Web servers may need to support different application policies atop common operating system platforms and networks.

COMMERCIAL APPLICATIONS:

The security policy definition and composition method and tool, when fully implemented, will provide a significant measure of confidence in the integrity and security of computer systems and network (e.g., world wide web) applications. As such, they will be marketed to both software producers and security service providers to make possible the enforcement and administration of single and composed separation-of-duty policies, and to help eliminate errors that lead to security exposures. The security policy definition and composition method and tool will also facilitate the development of separation-of-duty profiles by any industry, business, or government organization under the framework of the Common Criteria for information security technology.

DOC SBIR AWARDS BY STATE

Awards (Phase 1/Phase 2)

STATE	FY 94	FY 95	FY 96	FY 97	FY 98	TOTAL FY 85 - 98
AK	0	1/0	0/1	0	0	1/1
AL	0	3/0	2/1	0/1	3/0	8/2
AR	0	0	0	0	0	0
AZ	0	2/0	0	0	0	2/0
CA	9/0	14/6	7/5	6/5	7/2	66/31
CO	2/0	3/1	1/1	2/1	1/1	18/8
CT	1/2	2/1	0/1	2/0	0/1	10/6
DC	0	0	0	0	0	0
DE	0	0	1/0	0	0	1/0
FL	0	1/0	0	0	1/0	7/2
GA	0	0	0	1/0	0	1/0
HI	0	1/0	0/1	1/0	3/1	6/2
IA	0	0	0	0	0	0
ID	0	0	0	1/0	0	1/0
IL	2/0	1/2	0/1	1/0	0	6/4
IN	0	0	1/0	0/1	0	1/1
KS	0	0	1/0	0	0	1/0
KY	0	0	0	0	0	0
LA	0	1/0	0/1	1/0	1/1	5/2
MA	10/3	10/3	11/3	4/5	6/0	57/21
MD	3/1	6/1	2/0	6/1	6/2	33/5
ME	0	0	0	0	1/0	1/0
MI	1/0	2/1	0	3/0	1/0	7/1
MN	0	2/0	1/0	4/0	2/0	11/0
MO	0	2/0	0	0	0	3/0
MS	0	0	0	0	0	2/1
MT	0	0	0	0	0	0
NC	0	0	0	0	0	1/0
ND	0	0	0	0	0	0
NE	0	0	0	0	0	0
NH	0/1	0	0	1/0	0	3/2
NJ	2/0	0	2/0	2/0	1/1	10/4
NM	3/0	2/1	1/1	5/1	0/2	13/6
NV	0	0	0	0	0	2/1
NY	2/0	4/1	4/1	3/3	2/1	20/7
OH	0	2/0	1/1	4/0	1/1	9/3
OK	0	0	0	2/0	0	2/0

DOC SBIR AWARDS BY STATE

Awards (Phase1/Phase2)

STATE	FY 94	FY 95	FY 96	FY 97	FY 98	TOTAL FY 85 - 98
OR	0	1/0	0	0	1/0	3/0
PA	0	1/0	2/0	0	0	5/0
PR	0	0	0	0	0	0
RI	0	0	0	0	0	0
SC	0	0	0	0	0	0
SD	0	0	0	0	0	0
TN	0	0	0	0	0	0
TX	0	1/0	0/1	2/0	3/0	9/3
UT	0	0	0	0	0	0
VA	3/1	6/3	0	4/0	5/2	27/8
VT	0	0	0	1/0	0	1/0
WA	1/1	5/0	1/2	6/1	0/4	17/8
WI	0	0	0	0	0	1/0
WV	0	0	0	0	0	0
WY	0	0	0	1/0	0	1/0
TOTALS	39/9	73/20	38/21	63/19	45/19	372/129